Lesson 7 - Carbohydrates - Fuel For The Human Body

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1. Introduction

Before embarking on a study of carbohydrates—their role in the body, their sources, etc., we will begin by highlighting the importance of carbohydrates, defining what carbohydrates are and learning how they are formed, as well as glimpsing at a brief history of carbohydrates in the human diet.

1.1 The Importance of Carbohydrates

As mentioned in the RATIONALE earlier in this lesson, even the process of digestion could not occur without the energy provided by carbohydrates. Without carbohydrates we would not be able to think or move and our heart couldn't beat.

Whether it be digestion or circulation, thinking or walking, all life activities are dependent upon carbohydrates. When insufficient carbohydrates are available from the diet, the body converts fat reserves to carbohydrates for its use, and amino acids are utilized as carbohydrates instead of being used to make body protein.

1.2 What Are Carbohydrates?

As the lesson title implies, carbohydrates provide fuel, or energy, for the human body. These organic (carbon-containing) compounds are an integral part of both plant and animal life, and, as stated above, life as we know it could not exist without them.

Carbohydrates are made up of three elements: carbon, hydrogen and oxygen—carbohydrates. As you will learn in a later lesson, fats are also comprised of carbon, hydrogen and oxygen, but they have less oxygen and more carbon and hydrogen than carbohydrates.

Carbohydrates, along with proteins and fats, comprise the major components of living matter and are used for maintenance of cellular functional activities and as reserve and structural materials for cells. Because they are the primary source of energy for the animal kingdom, carbohydrates are particularly important in a study of nutritional science.

1.3 How Carbohydrates Are Formed

Carbohydrates are formed by green plants in the process of photosynthesis. In photosynthesis, plant chlorophyll, plant enzymes, sunlight, carbon dioxide from the air, and mineralized water from the soil combine and, in a complicated process, synthesize carbohydrates. Humans obtain their carbohydrate needs most efficiently from the plant world.

1.4 Carbohydrates: Past and Present

In the past and in some parts of the world today, people's diets consisted largely of carbohydrate foods, especially those growing locally. In most of the Western world today, however, meats and other protein/fat foods comprise a disproportionate part of the diets of many people, and processed and refined carbohydrate products are being consumed in lethal quantities.

While people do survive, at least for a relatively short lifespan, on diets high in proteins and refined carbohydrates, this survival is low-level survival, with suffering from illnesses of numerous varieties being considered the norm. A high-level state of health and well-being is possible only if our needs are met in keeping with our biological adaptation and if destructive practices are removed from our lives. The further we carry this, the healthier and happier we will be, for joy is supposed to be our primary experience in life— not suffering.

During the past 70 years or so, more and more food processing and refining establishments have been created, and they are producing horrendous qualities of highly-refined, highly-processed and highly-chemicalized so-called "foods." An extremely large proportion of these "foods" are carbohydrates—that is, they provide energy in the form of calories. But they are not real foods because they lack many of the elements from the original food source that make a food a food. For example; the germ and bran are removed from wheat, leaving only starch; and the vitamins, minerals and fiber that need to be with the starch to make the wheat a whole food are missing. Removing natural food components and then attempting to put them back by adding specified amounts of synthetic vitamins and minerals, by using bran separate from the whole wheat berries, and by taking food supplement pills and powders is the height of absurdity. First of all, it's not effective, and secondly, it's expensive, time-consuming and, most of all—UNNECESSARY!

Even physiology texts, which are medically oriented rather than health oriented, say that a casually selected diet of carbohydrates is likely to be poor in the essential amino acids, vitamins and minerals. Life Scientists/Natural Hygienists recognize the necessity of high-quality carbohydrates in the diet and the need to eschew the products marketed by the food industries; Hygienists advocate a return to a high-carbohydrate diet consisting of whole foods, with fiber intact, that provide our needs for complete proteins, vitamins and organic minerals.

2. Classification Of Carbohydrates

Carbohydrates, also known as *saccharides*, are classified according to the number of single carbohydrate molecules in each chemical structure. Carbohydrate compounds having just one carbohydrate molecule are called *monosaccharides*; compounds with two carbohydrate molecules are called *dissarcharides*; and those compounds containing more than two carbohydrate molecules are named *polysaccharides*. All carbohydrates either are monosaccharides or can be hydrolyzed (broken down) into two or more monosaccharides.

For further understanding of these different classifications of carbohydrates, the monosaccharides and disaccharides can be grouped together and compared with the polysaccharides. This can be done because monosaccharides and disaccharides have certain things in common.

For one, they are both water soluble. In addition, they have a sweet taste and a crystalline structure. The monosaccharides and disaccharides are called *sugars* and all share the suffix, *-ose*, meaning *sugar.*

Polysaccharides, in contrast to mono- and disaccharides, are insoluble in water, do not taste sweet and do not form crystals. Also, they do not share a suffix and have no group name (such as sugars, in the case of mono-arid disaccharides). They are sometimes called starches, but this is technically incorrect because there are many other classifications of polysaccharides besides starches (cellulose and glycogen being two and dextrin being another).

2.1 Monosaccharides

These are the only sugars that can be absorbed and utilized by the body. Disaccharides and polysaccharides must be ultimately broken down into monosaccharides in the digestive process known as *hydrolysis*. Only then can they be utilized by the body. Three monosaccharides are particularly important in the study of nutritional science: glucose, fructose and galactose.

2.2 Glucose (also known as dextrose or grape sugar)

This monosaccharide is the most important carbohydrate in human nutrition because it is the one that the body fuses directly to supply its energy needs. Glucose is formed from the hydrolysis of di- and polysaccharides, including starch, dextrin, maltose, sucrose and lactose; from the monosaccharide fructose largely during absorption; and from both fructose and galactose in the liver during metabolism.

Glucose is the carbohydrate found in the bloodstream, and it provides an immediate source of energy for the body's cells and tissues. Glucose is also formed when stored body carbohydrate (glycogen) is broken down for use.

In the plant world, glucose is widely distributed. It is found in all plants and in the sap of trees. Fruits and vegetables are wholesome food sources of glucose. It is also present in such unwholesome (to humans) substances as molasses, honey and corn syrup.

2.3 Fructose (also known as levulose or fruit sugar)

Fructose, a monosaccharide, is very similar to another monosaccharide, galactose. These two simple sugars share the same chemical formula; however, the arrangements of their chemical groups along the chemical chain differ. Fructose is the sweetest of all the sugars and is found in fruits, vegetables and the nectar of flowers, as well as in the unwholesome (to humans) sweeteners, molasses and honey. In humans, fructose is produced during the hydrolysis of the disaccharide, sucrose.

2.4 Galactose

Galactose differs from the other simple sugars, glucose and fructose, in that it does not occur free in nature. It is produced in the body in the digestion of lactose, a disaccharide.

2.5 Disaccharides

Disaccharides, on hydrolysis, yield two monosaccharide molecules. Three particular disaccharides warrant discussion in a lesson on nutritional science: sucrose, maltose and lactose.

2.6 Sucrose

The disaccharide, sucrose, consists of one molecule of each of two monosaccharides—glucose and fructose. Sucrose is found in fruits and vegetables and is particularly plentiful in sugar beets (roots) and sugarcane (a grass). Refined white and brown sugars are close to 100% sucrose because almost everything else (including the other kinds of sugars present, the vitamins, the minerals and the proteins) have been removed in the refining process. Maple syrup and molasses are, like refined sugars, unwholesome sweeteners; both contain over 50% sucrose. It almost goes without saying that any foods, so-called, containing significant amounts of refined sugar are high in sucrose.

2.7 Maltose (also known as malt sugar)

This disaccharide, unlike sucrose, is not consumed in large amounts in the average American diet. It is found in malted cereals, malted milks and sprouted grains. Also, corn syrup is 26 percent maltose and corn sugar is 4 percent maltose. None of these "foods" is wholesome, with perhaps, the exception of sprouted grains.

Maltose occurs in the body as an intermediate product of starch digestion. (Starch is a polysaccharide.) When maltose is hydrolyzed, it yields two molecules of glucose.

2.8 Lactose (also known as milk sugar)

This disaccharide is found only in milk. Human milk contains about 4.8 g per 100 ml and cow's milk contains approximately 6.8 g per 100 ml. When lactose is hydrolyzed it yields one unit of the monosaccharide glucose and one unit of the monosaccharide galactose. The enzyme lactase is needed to digest lactose, and this enzyme is not present in most, if any, people over age three. This is one of the many reasons why milk is an unwholesome food for people over three years of age.

2.9 Polysaccharides

Like the disaccharides, the polysaccharides cannot be directly utilized by the body. They must first be broken down into monosaccharides, the only sugar form the body can use.

Polysaccharides contain up to 60,000 simple carbohydrate molecules. These carbohydrate molecules are arranged in long chains in either a straight or in a branched structure. There are four polysaccharides that are important in the study of nutritional science: starch, dextrin, glycogen and cellulose.

2.10 Starch

Starch is abundant in the plant world and is found in granular form in the cells of plants. Starch granules can be seen under a microscope and they differ in size, shape and markings in various plants. The starch granules of wheat, for example, are oval-shaped; whereas the starch granules of corn are small, rounded and angular.

These starch granules are laid down in the storage organs of plants—in the seeds, tubers, roots and stem pith. They provide a reserve food supply for the plant, sustain the root or tuber through the winter and nourish the growing embryo during germination.

Most starches are a mix of two different molecular structures, amylose and amylopectin. The former has a linear structure and the latter has a branched or bushy structure. The proportion of the two fractions varies according to the species of plant. For example, potato starch and most cereal starches have approximately 15-30% amylose. But the waxy cereal grains, including some varieties of corn plus rice and grain sorghum, have their starch most entirely as amylopectin. The starches in green peas and in some sweet corn varieties are mainly amylose.

The polysaccharides, as mentioned earlier, are not water soluble as are the mono- and disaccharides. Though not water soluble, starches can be dispersed in water heated to a certain temperature. The granules swell and gelatinize. When cooled, this gelatin sets to a paste. The jelling characteristics of starches are considered to result from the amylose present, while amylopectin is considered to be responsible for the gummy and cohesive properties of the paste.

2.11 Dextrin

There are several "varieties" of this polysaccharide. Dextrins are most commonly consumed in cooked starch foods, as they are obtained from starch by the action of heat. Dextrins are intermediary products of starch digestion, also, and are formed by the action of amylases on starches. They render the disaccharide maltose on hydrolysis.

2.12 Glycogen

Glycogen is the reserve carbohydrate in humans. It is to animals as starch is to plants. Glycogen is very similar to amylopectin, having a high molecular weight and branched-chain structures made up of thousands of glucose molecules. The main difference between glycogen and amylopectin is that glycogen has more and shorter branches, resulting in a more compact, bushlike molecule with greater solubility and lower viscosity (less stickiness or gumminess).

Glycogen is stored primarily in the liver and muscles of animals. About two-thirds of total body glycogen is stored in the muscles and about one-third is stored in the liver.

2.13 Cellulose

Like starch and glycogen, cellulose is composed of thousands of glucose molecules. It comprises over 50% of the carbon in vegetation and is the structural constituent of the cell walls of plants. Cellulose is, therefore, the most abundant naturally-occurring organic substance. It is characterized by its insolubility, its chemical inertness and its physical rigidity. This polysaccharide can be digested only by herbivores such as cows, sheep, horses, etc., as these animals have bacteria in their rumens (stomachs) whose enzyme systems break down cellulose molecules. Humans do not have the enzyme needed to digest cellulose, so it is passed through the digestive tract unchanged.

3. The Role Of Carbohydrates In The Body

Five subheadings follow in this lesson subdivision, but there is actually only one basic role of carbohydrates in the human diet: to supply energy. It should always be kept in mind that carbohydrates or calories alone cannot adequately supply our energy needs, for we must have our carbohydrates in combination with other needs, such as proteins, water, vitamins, minerals, fats, etc. This means that a diet of refined sugar, refined rice, flour products and other "food fragments," though it supplies calories, cannot satisfactorily comprise the bulk of anyone's diet. A person on such a diet would suffer many problems, for the organism is not capable of living long or well on bare carbohydrates alone. They must be obtained in combination with the other essential food factors to be truly useful in the overall energy production and nutrition of the organism.

3.1 Carbohydrates Supply Energy

The body uses carbohydrates directly from the monosaccharide glucose. Glucose is in the blood and extracellular fluids (lymph) and can be made from glycogen. Glycogen is stored in the liver and muscles and in smaller amounts in the other organs and tissues of the body. Energy is derived from glucose by the splitting of the glucose molecules into smaller compounds and oxidizing these to form water, which frees quite a large amount of energy.

When carbohydrates needed for the functioning of the central nervous system, the muscles and the other body systems and functions are insufficient in the diet (as during a fast or on a weight-loss diet), stored adipose tissue (fat) is broken down into glucose to make up the caloric deficit. Some amino acids, instead of being used to make proteins, are deaminated and used as carbohydrates to supply energy. The formation of glucose from amino acids is called gluconeogenesis. This phenomenon enables one to maintain normal blood sugar levels during a fast.

Practically the entire fat store of the body can be used up without detriment to health. Because of this fact, and the fact that the body can also create carbohydrates from amino acids, fasting is a very safe practice from the standpoint of maintenance of normal blood sugar levels, of normal neurological functioning and of meeting all the body's various energy needs.

3.2 Carbohydrates Provide Fuel for the Central Nervous System

Nerve cells are very dependent upon glucose for their functioning. According to physiology texts, the glycogen in nervous tissues remains constant and is not mobilized for conversion to glucose. When insufficient carbohydrates are consumed to meet the energy needs of the central nervous system, besides the occurrence of gluconeogenesis, another phenomenon occurs during a fast of three weeks or more: The cells of the central nervous system adapt their metabolic apparatus to use ketone bodies in place of glucose. (Ketone bodies are substances synthesized by the liver as a step in the metabolism of fats.) The nerve cells obtain their needed functional energy from these metabolites. This explains why patients with blood sugar problems (diabetes or hypoglycemia) do not suffer ill effects during a fast. In fact, they benefit by fasting. (This topic will be discussed in depth in a later lesson.)

3.3 Carbohydrates Provide Fuel for the Muscular System

Carbohydrates provide the major fuel for muscular exercise. Fats and proteins can be used only indirectly—by first being converted into carbohydrates. For this reason, a proper diet should consist primarily of carbohydrates—not primarily of proteins and fats as are commonly consumed in conventional nonvegetarian (and some lacto- and lacto-ovo vegetarian) diets.

The muscles use the glycogen present in the muscle cells and glucose in the bloodstream. However, glycogen from the muscles is more efficiently used than glucose because the breakdown of glycogen for use does not require energy input at the time, whereas a certain amount of energy is used to bring the blood sugar into the metabolic system of the muscles. (It does require energy to build up the glycogen supply in the first place, but this happens during periods of rest when plenty of energy is available.)

If a diet high in carbohydrates is not consumed, tremendous muscular exertion over long periods and/or extreme and prolonged stress (as being stranded for weeks in Antarctica) can result in accelerated breakdown of body protein and stored body fat. The protein breakdown is evidenced by an increased excretion of nitrogen in the urine, and the fat breakdown is evidenced by a rise in the level of ketone bodies in the urine and in the blood. The blood sugar level is simultaneously lower.

The body works much more efficiently from carbohydrate intake than from broken-down body protein and fats because protein and fat molecules, when used as fuel, yield less than their total caloric value in the form the muscles can use. The remaining portion is used for the conversion of these molecules into suitable fuel. This conversion takes place in the liver and adipose tissue, which supply the body's organs with fuel via the bloodstream.

The fact that the body can and will use body fats and proteins when the supply and stores of blood sugar and glycogen are not great enough to meet the demand for energy exemplifies two facts: 1) The organism is provident. It has many back-up arrangements for survival in emergency situations when sufficient carbohydrates are not available. 2) An appropriate balance between supplying body needs (such as rest and carbohydrates) and expending energy (muscular, nervous or other) should be strived for to attain optimum health and well-being.

It has been found that people who are accustomed to doing prolonged or strenuous work have larger stores of glycogen (and of phosphate esters) in their muscles than those not accustomed to much physical activity. It is, therefore, beneficial to do regular vigorous exercise to increase our storage of muscle glycogen. We will then be prepared to expend energy for longer and more strenuous exercise—whether it be in an emergency or in pursuing pleasure.

3.4 Carbohydrates Supposedly Spare Proteins

Physiology textbooks refer to this so-called role or function of carbohydrate in the body as "its protein-sparing action." However, it is incorrect to attribute action (other than chemical action) to carbohydrates or other inanimate substances. Besides, "sparing protein" is not a function or role of carbohydrates at all. Carbohydrates simply furnish our fuel or energy needs—and nothing more.

What is being said in the textbooks is that proteins consumed will be used for tissue building and maintenance rather than being used as an emergency source of energy as long as the carbohydrate intake is sufficient. This is true, but it is only another way of saying that carbohydrates are the primary and most efficient source of energy or fuel and that it is best not to try to meet our fuel needs from proteins. It is stating the true fact that carbohydrates, not proteins, supply our primary nutrient needs.

"Sparing proteins" is not a separate and distinct function or role of carbohydrates any more than preventing scurvy is a separate and distinct function of vitamin C in the body. Vitamin C supplies body needs, but its role is not prevention of scurvy or of anything else. Viewing nutrients as preventative agents of diseases is another way of saying that diseases are normal, that they are an inevitable part of life that will and must occur unless prevented by the proper nutrients. That is a backwards way of viewing health—it's the disease approach, or the medical approach. Just as good things happen to us if we think positive thoughts and visualize success, harmony, etc., good health will exist as long as we live healthfully—and that includes consuming the correct amounts of the foods to which we were biologically adapted in nature to eat.

In short, the so-called "protein-sparing action" of carbohydrates is not only not an action, but sparing proteins is not a distinct role of carbohydrates separate from their energy-providing role.

3.5 Carbohydrates Supposedly Supply "Dietary Fiber"

"Dietary fiber" is a fairly new term coined to describe the cellulose inside plant cells. Cellulose is known to be indigestible by humans, though it is digested and used for energy by herbivores. The claims made about "the beneficial role of dietary fiber in preventing diseases" are so popular and so widely made that they are practically accepted as fact. However, cellulose, though in fact a carbohydrate because it is utilized as such by herbivores, does not serve the role of a carbohydrate in human physiology. Because it cannot be digested and utilized by humans, it cannot provide us with energy—and providing energy is the only role of carbohydrates in human nutrition.

The above statements may come as a surprise to most readers—but read on and we'll clarify further.

It has been observed that certain so-called primitive tribes in Africa and elsewhere who consume diets high in fiber are less likely to develop certain colon diseases and metabolic disorders than their kinsmen who live in urban areas and eat low-fiber foods similar to those consumed in so-called developed countries. Based on the high correlation between low-fiber diets and human gastrointestinal diseases, many hospitals and clinics have changed their dietary management of diverticulosis. They are experiencing good results with a diet containing more instead of less cellulose.

We do not deny that high-fiber diets are more wholesome as a rule than low-fiber diets, nor do we deny the fact that people who consume diets closer to nature and therefore higher in fiber (cellulose) have fewer gastrointestinal diseases and a lower rate of bowel cancer. What we argue against is the thinking that the fiber itself is primarily responsible for the prevention of these diseases and disorders.

Since cellulose is indigestible, it cannot be utilized by the body as a nutrient. It is simply passed through with the other wastes. Its presence or absence in the feces is insignificant. What is significant is how much and what kinds of toxins are there (and elsewhere). The ingestion of too many toxins from all sources, as well as the retention of toxic wastes produced within the body, results in diseases. The presence or absence of indigestible plant fibers does not prevent or cause diseases.

Processed, highly-refined, so-called foods (they do contain carbohydrates) do not deserve the label *foods* because they are not *whole foods*. Parts of processed foods are missing—they were removed intentionally in the refining process. (Fiber [cellulose] is one of those missing parts.) This makes them incomplete or fragmented foods. Eating fragmented foods results in problems in the body. Therefore, they should not be eaten.

Refined sugar and products containing refined sugar, as well as refined flour products, are the most salient examples of processed food fragments that produce toxic effects in the body. Being devoid of vitamins and minerals in their natural form (the only form they can be used in), these products are like drugs within the body. In addition, calcium and other minerals, as well as B vitamins, must be utilized by the body to metabolize refined products. Because the refined products are devoid of nutrients except carbohydrates, calcium is taken from the bones.

Most "civilized" diets contain cooked foods, foods not normal to humans, refined and processed foods and drugs and medications. Refined sugar, flours, white rice and processed cereals are some of the worst culprits, but there are many, many more sources of toxins in the diet. Also, incompatible food combinations result in the production of toxins in the stomach and elsewhere in the digestive tract, and these toxins also contribute to gastrointestinal disturbances and diseases.

Much more could be said about the sources of toxins within the body that result in disease, but this has been discussed in previous lessons and will also be further discussed in future lessons. For now, it is sufficient for us to explain that low-fiber diets not only lack the natural cellulose which should be left intact in the whole food, but they also contain or give rise to a host of toxins that result in disease conditions. It is not the lack of fiber itself that causes diverticulosis and other gastrointestinal problems but the overall unwholesomeness of the foods ingested in so-called civilized society. (Of course, you should understand that what is eaten is only part of the picture and that how it's eaten, how much is eaten, the amount of exercise, sleep, fresh air, etc., indulged are also important factors in human

nutrition.)

4. How Carbohydrates Are Digested And Used By The Body

4.1 Introduction to Digestion

Before discussing carbohydrate digestion in particular, let's give a little attention to digestion in general. Complete and thorough digestion of foodstuffs is extremely important for good health. A tremendous amount of toxin elimination and accumulation puts a great stress and burden upon the organism and results in a large variety and number of diseases. This happens both directly, from the presence of accumulated toxic substances that the body was unable to eliminate, and indirectly, from a decrease in the body's digestive capabilities due to overworking the digestive system and depleting the body's supply of vital energy.

It is, therefore, important for us to do everything we can to insure thorough and complete digestion of all foods eaten. This can be done by eating primarily (or only) easily digested and uncomplicated foods such as fruits; by eating compatible combinations of foods; by eating moderate amounts of foods; by eating at well-spaced meals; by abstaining from drinks during or too soon before or after meals; and by refraining from eating while under stress or emotionally upset.

One of two things happens to foods that do not get thoroughly or completely digested: 1) Sugars may ferment or 2) proteins may putrefy (rot). These processes result from bacterial activity which breaks down (decomposes) undigested or undigestible foods in preparation for their elimination from the body. The "trick" to, getting nourishment (nutriment) from the foods you eat is to see to it that they, get digested quickly, before the bacteria (present within every healthy digestive tract) have a chance to decompose them. The results of bacterial decomposition are toxic and do not provide nourishment. Foods that don't digest relatively soon after ingestion will ferment or putrefy and contribute to body toxicity and disease.

Keeping the above facts about digestion in mind, let's take a look now at carbohydrate digestion.

4.2 Salivary Carbohydrate Digestion

Disaccharides and polysaccharides must be digested before the body can use them, while monosaccharides do not require digestion. For this reason, as well as for other reasons (to be discussed in depth later in this lesson), our best source of carbohydrates is from fruits. Fruits require much less of the body's energies and render primarily monosaccharides that, as stated, need no digestion.

Digestion is both a mechanical process (chewing) and a chemical process (enzymic actions). The class of enzymes that hydrolyze carbohydrates are broadly known as *carbohydrases*. We will be concerned in this lesson with carbohydrases known as *amylases*.

While the digestion of all types of foods (proteins, carbohydrates, fats, etc.) begins in the mouth with the mechanical process of mastication, certain carbohydrates—namely, starches and dextrins—are the only food types whose chemical digestion begins in the mouth. Here an enzyme known as *salivary amylase* or *ptyalin*, secreted by the *parotid glands*, is mixed with the food during the chewing process and begins the conversion of glycogen, starch and dextrins into the disaccharide maltose.

What happens when the starches, dextrin, and glycogens that were not converted to maltose in the mouth and what happens to the maltose when these carbohydrates reach the stomach depends upon several factors—what other types of foods are eaten with the starch, how much food is being eaten and how fast, the emotional condition of the eater and the condition of the eater's digestive system. If a relatively uncomplicated starch such as potatoes or yams is eaten alone or with nonstarchy vegetables, and no proteins (as meats, cheese or milk, or even nuts or seeds or acids (as tomatoes, lemon or lemon juice or vinegar—as in salads or salad dressings) are consumed with the starchy food, salivary amylase (ptyalin) can and will continue the digestion of starches and dextrins in the stomach for a long period.

For thorough digestion and consequent good health, this continuation of starch digestion by ptyalin in the stomach is a necessity. Therefore, for good health, it is important to consume starchy foods at separate meals from protein foods and acids. (This and other facts relative to the topic of food combining for good digestion will be discussed in depth in later lessons.)

Briefly stated, ingestion of protein foods causes a secretion of hydrochloric acid in the stomach, and hydrochloric acid destroys ptyalin; that is, it destroys the amylase activity and substitutes acid hydrolysis. Physiology texts state that "if this acid hydrolysis was continued long enough it could reduce all the digestible carbohydrates to the monosaccharide stage. However, the stomach empties itself before this can take place."

The acids of tomatoes, berries, oranges, grapefruits, lemons, limes, pineapples, sour grapes and other sour fruits and the acid of vinegar will, like hydrochloric acid, destroy our only starch-splitting enzyme, ptyalin. Therefore, these foods also inhibit starch digestion. For good digestion and consequent good health, acids should not be eaten at the same meal with starches.

Another factor that can impair salivary starch digestion is the drinking of water or other liquids with or too soon before or after meals. Water or other liquids do not aid in the digestion of foods. On the contrary, they interfere with digestion by diluting the digestive juices and cause them and their enzymes to be passed through the digestive tract too quickly for digestion to occur.

To summarize this aspect of starch digestion, taking proteins, acids, water or other liquids with starches interferes seriously with their digestion by the salivary amylase, ptyalin. This first stage of starch digestion is of great importance because there is a great likelihood that the food will be acted upon by bacteria and ferment before it reaches the intestine where further starch digestion can take place. Digestion, rather than fermentation and its resulting toxic byproducts, is much more likely to occur soon after the food is put into the mouth than further along in the digestive tract.

From the above, you can see why thorough mastication of food is so important when starches are eaten. No one who seeks health should eat starches in a hurry, nor should they have them with a beverage or with proteins or acids, for good digestion of foods is imperative for good health.

A special note should be made here about glycogen—animal starch. Glycogen should not be consumed by health seekers because much disease results from the ingestion of animal flesh and animal products. This will be discussed in depth in later lessons. For the purposes of this lesson, suffice it to say that glycogen ingested cannot be digested in the stomach because, of the hydrochloric acid that will be secreted to digest the protein, which is the primary nutritive component of foods that contain glycogen. Therefore, whatever glycogen that is not converted to a disaccharide by the salivary amylase, ptyalin, must be converted in the intestine. The likelihood of the glycogen reaching the intestine without fermenting before it can get there is small. This is just one of the many hazards of consuming animal flesh and animal foods.

4.3 Starch Digestion in the Intestine

Now that we have discussed starch digestion by the enzyme ptyalin, let's get into starch and sugar (disaccharide) digestion in the intestine.

Whatever carbohydrates make it to the intestine quickly enough to escape fermentation by bacterial action will be acted upon in the first part of the small intestine, the duodenum, by *pancreatic amylase*. This enzyme, secreted by the pancreas, converts any remaining dextrin and starch to maltose. The reason this amylase can act in the intestine is because of the more alkaline medium which prevails there. As stated earlier, amylase must have a somewhat alkaline medium to do its job and is destroyed by acids.

At this stage in the digestive process, that is, after the polysaccharides (starch, dextrin and glycogen) have been converted to the disaccharide maltose, maltose and the other disaccharides (sucrose and lactose) must be converted to monosaccharides since, as stated earlier, the body can absorb and use sugars only as monosaccharides. This is accomplished by the amylases maltase (to convert maltose), sucrase (to convert sucrose) and lactase (to convert lactose). These amylases are secreted by the wall of the small intestine and are capable of splitting the particular sugars for which they were designed to the monosaccharide stage.

4.4 Carbohydrate Absorption

Even though some substances (water, ethyl alcohol, small amounts of monosaccharides) may be absorbed into the bloodstream through the mucosa (mucous membrane) of the stomach, most absorption of the soluble products of digestion occurs in the small intestine. There the absorptive surface is increased about 600 times by villi, which are fingerlike projections in the lining of the small intestine. Each individual villus contains a network of capillaries surrounding a lymph vessel, and each cell on the surface of the villus is made up of smaller units called brush border cells or micro villi.

Substances or nutrients pass through the intestinal membrane through the process of *osmosis* in one of two ways: 1) *diffusion* or 2) *active transport*. Substances and nutrients in the intestinal tract that are in higher concentration than across the membrane in the blood and lymph pass through by diffusion. This is a simple osmotic process in which no energy has to be expended. Fructose is absorbed by diffusion.

Active transport is the osmotic process used when substances or nutrients are absorbed from an area of lower concentration across a membrane to an area of higher concentration. This process requires energy for the absorption, as well as a "carrier" to transport the substance. The carrier substance is thought to be a protein or lipoprotein (a combination of a protein and a fat). Glucose and galactose are absorbed into the bloodstream by active transport. Monosaccharides are absorbed by the capillaries, which empty into the portal vein, which in turn carries them directly to the liver.

4.5 Carbohydrate Metabolism

Metabolism is the term used to describe the many chemical changes that occur after the end products of digestion have been absorbed into the body. There are two phases of metabolism: 1) *anabolism*, which is the chemical reaction by which absorbed nutrients are utilized for replacement of used or worn-out body substances (maintenance) and to create new cellular material (growth), and 2) *catabolism*, which includes the chemical reactions whereby cellular materials are broken down into smaller units. An example of anabolism is the use of monosaccharides to build up stores of muscle and liver glycogen, and an example of catabolism is the breaking down of these glycogen stores to supply energy to the muscles during physical exersion. Anabolism and catabolism occur simultaneously in the body cells.

4.6 Sources of Glucose

The body's immediate needs determine whether carbohydrates that have been digested and absorbed are used for immediate energy, converted and stored as glycogen or changed to fat and stored in adipose tissue.

Glucose is the principal sugar used by body cells and tissues. It is, therefore, important to know the sources of this nutrient. It may come from carbohydrates or from noncarbohydrate sources. Following

are the four primary sources of glucose:

a. *From the digestion of dietary carbohydrate*. Glucose is formed from the digestion of starch, dextrin, maltose, sucrose and lactose from the foods we eat.
b. *From the conversion of fructose and galactose*. The three monosaccharides—fructose, galactose and glucose—share the same chemical formula. However, they differ in the arrangement of the hydrogen and oxygen units along the carbon chain. During the metabolic process, the liver cells convert absorbed galactose molecules and some fructose molecules. However, fructose is mainly converted to glucose during its absorption through the intestinal walls, where a metabolic interconversion (mutual conversion) occurs.
c. *From the breakdown of glycogen*. When the body's need for glucose is greater than the supply available in the blood, glycogen reserves in the liver and muscles are broken down and converted to glucose.
d. *From noncarbohydrate sources*. If the body cells require more energy than can be supplied by glucose and glycogen reserves, noncarbohydrate sources can be used to supply glucose. The noncarbohydrate sources used include certain amino acids from protein, glycerol from fat and, indirectly, fatty acids from fat.

4.7 Regulation of Blood Glucose Concentration

The liver, the pancreas and the adrenal glands play roles in keeping the blood sugar level at a normal concentration of around 90 mg. per 100 ml.

a. *The liver serves as a buffer.* As stated earlier in this lesson, absorbed monosaccharides are carried in the portal vein to the liver. This blood in the portal vein may have a very high concentration of sugars, as much as 180 mg per 100 ml of glucose. In the liver, about two-thirds of the excess glucose is removed from circulation. This glucose is converted to glycogen, the storage form of carbohydrate for animals (sometimes called animal starch). At a later time, when the blood sugar level is low, the glycogen is split back into glucose and is transferred out of the liver into the blood.
   In essence, the liver serves as a "buffer" organ for blood glucose regulation because it keeps the blood glucose level from rising too high or falling too low.

b. *Hormones that regulate the blood sugar level*. After a meal is eaten, the increased glucose level in the blood (about one-third of the glucose is not removed from circulation by the liver) stimulates the pancreas to produce the hormone, insulin, which promotes the rapid transport of glucose into the cells, thus decreasing the blood glucose level back toward normal. Glucose cannot enter the cells through simple diffusion because the pores of the cell membrane are too small. Therefore, it is transported by a chemical process called *facilitated diffusion* (also called active transport), in which the glucose combines with a carrier in the cell membrane and is transported to the inside of the cell, where it breaks away from the carrier.

   Insulin greatly enhances this facilitated transport of glucose through the cell membrane. In fact, only a very small amount of glucose can combine with the carrier in the absence of insulin, whereas, in the presence of normal amounts of this hormone, the transfer is accelerated as much as 3-5-fold. (Larger than normal amounts of insulin increase the rapidity of glucose transfer as much as 15-20-fold.) As you can see, insulin controls the rate of glucose metabolism in the body by controlling the entry of glucose into the cells.

   Three hormones are involved in increasing the concentration of glucose in the blood when necessary: *norepinephrine*, *epinephrine* and *glucagon*. Norepinephrine and epinephrine are secreted by the *adrenal glands* and glucagon is secreted by the *pancreas*. These hormones cause liver glycogen to split into glucose, which is then emptied into the blood. This returns the blood glucose concentration back toward normal.

4.8 How Energy is Derived From Glucose

Energy is derived from glucose in one of two basic ways: 1) by *oxidation* and 2) by *glycolysis*. By far the major amount of energy from glucose is released in a series of reactions in the cells in the presence of oxygen; but some energy from glucose is released by a process called glycolysis. This is an involved process which does not require the presence of oxygen. (A detailed explanation can be found in a physiology text such as *Physiology of the Human Body* by Arthur C. Guyton, M.D.)

4.9 Carbohydrates in Relation to Other Nutrients

Not only are fats converted to carbohydrates for energy when carbohydrate intake is inadequate, but when carbohydrates are consumed beyond need, the excess is converted to fat and stored in adipose tissue. Also, the B-complex vitamins and the mineral calcium are known to play an integral part in carbohydrate metabolism.

a. *The transformation of carbohydrate into fat*. Fats and carbohydrates eaten in excess of caloric expenditure are deposited in the adipose tissues as fat. It is, therefore, incorrect to label carbohydrates as being "fattening." Fats eaten in excess of caloric need are also stored as fat. In the diets of many people, however, carbohydrates comprise the foodstuffs most commonly eaten in excess. There are many reasons for this. One reason is because refined sugar and flour are used so heavily and widely in the processing of the foods most widely advertised and distributed to the retail food outlets. Carbohydrates are, as a general rule, less expensive than fat-containing foods (such as cheeses, nuts, many meats, etc.) therefore, they are more likely to be overeaten. In addition, because humans naturally "have a sweet tooth" (because we are biologically frugivores, adapted in nature to eat fruits), we are more attracted to carbohydrates than to fats.
   The chemical pathway glucose follows on its way to fat is well understood. You may study this in a good physiology text.

b. *The vitamin B complex in carbohydrate nutrition*. The importance of the B vitamins in carbohydrate metabolism was discovered because of the health problems that resulted from the industrial processing of foods which removed (and still removes today) the B vitamins from their whole food sources where they were packaged by nature side-by-side with carbohydrates. The large-scale introduction of white (refined) rice in the Orient resulted in beriberi, a vitamin B complex deficiency—specifically, a thiamine deficiency. This phenomenon led to the recognition of the existence of this group of vitamins.
   Prior to the widespread processing of foods, humans did not suffer as a result of their lack of knowledge about the existence of the B vitamins because in nature there is a union between the vitamin B complex and carbohydrates in foods. This union was broken by the industrial processing of foods.

   As will be discussed in greater depth in later lessons, taking vitamin B complex supplements or using so-called "enriched" processed food products will not and cannot substitute for whole foods in their natural state. It is, therefore, very important for health-seekers to consume unprocessed foods—also uncooked, as cooking is an in-home method of food processing that is very destructive of the quantity and quality of vitamins and other nutrients in foods.

   B-complex vitamins are also depleted (and/or not synthesized in the body) when various drugs and medications are taken, most notably birth control pills, alcoholic beverages and antibiotics. Other drugs also deplete B vitamin supplies and/or hinder the synthesis of B vitamins in the intestine. A future lesson will be devoted to the effects of various drugs and medications upon nutrition.

   Physiology texts also mention the fallacy of regarding any one B vitamin in the complex as more important than another because of the fact that the normal chain of events, physiologically speaking, can be broken by a lack of any one of the B vitamins. The texts also recommend a

dietary supplement containing all the factors to "avoid the evils of modern food refinement." It is appropriate to make a comment here on this subject: It is fully possible, in fact, easily possible, to "avoid the evils of modern food refinement" much more completely and many times more effectively as far as good (healthful) results are concerned than by eating refined foods and taking supplements. Actually, it is not only easily possible and desirable to completely avoid ever eating refined foods, but it is essential for anyone who wants and expects to regain and/or maintain good health. It is not possible to have truly high-level health while continuing to indulge those very practices which undermine it, and eating processed foods and taking food supplements both undermine health.

Please make special note of the above, for it is one of the most important facts you need to completely understand and accept if you are to bring yourself and your clients to a high level of well-being.

c. *Calcium in carbohydrate metabolism*. Like the B-complex vitamins, calcium is essential in the metabolism of carbohydrates. When calcium is present in context with the carbohydrate source (whole foods), there are no problems. But, with today's high consumption of refined foods, lack of natural calcium in these foods creates a myriad of very serious health problems. Refined sugar and flour, as well as rice, breads, packaged cereals and pastas, have been robbed of the calcium in the plant during processing and refining. Even whole-grain products may completely lack calcium because of the destruction of this mineral during the destructive processes of cooking and baking.

   Calcium is taken from the bones and teeth to meet the needs for this important mineral in carbohydrate metabolism. Dental caries, osteoporosis and other bone diseases result.

5. Sources Of Carbohydrates

5.1 Carbohydrates Are a Component of Every Food

As mentioned earlier in this lesson, carbohydrates, along with proteins and fats, form the major components of living matter. They maintain the functional activity of the cells and serve as structural and reserve materials. Carbohydrates provide the primary source of energy for humans.

There is not a single living thing—plant or animal—that does not contain carbohydrates in some form. Though the quantity and form of carbohydrates varies, the presence of carbohydrates as an integral component of life is constant. This means that all foods are potential sources of carbohydrates. However, some foods are better sources than others, and this is what we will discuss now.

5.2 Carbohydrates Are a Primary Component of Some Foods

Most foods can be readily classified according to the organic compounds (proteins, carbohydrates, fats, etc.) they contain in greatest abundance. These classifications are not only useful for identifying where to obtain the nutrients we need, but they are also invaluable in selecting compatible food combinations for best digestion and nutrition (to be discussed in depth in a later lesson).

5.3 Starches As Sources of Carbohydrates

Starch-containing foods can be divided into four classifications:

Starchy Vegetables All kinds of potatoes are in this classification. Also included are yams, winter squashes (such as buttercup, hubbard and banana squashes), pumpkin, caladium root, taro root, cassava root and Jerusalem artichokes. (Note: Technically, squashes and pumpkins are fruits.)

Mildly starchy vegetables This classification includes carrots, cauliflower, beets, rutabaga and salsify.

Cereal grains This includes all cereals, whether they're whole or refined, raw or cooked. Examples are wheat, rye, barley, rice, millet, buckwheat and oats.

Legumes This includes peanuts, lentils, peas and beans.

5.4 Fruits As Sources of Carbohydrates

Because some nonsweet foods such as nuts, bell peppers, squashes, cucumbers and tomatoes are technically fruits, fruits can be divided into two classifications: 1) sweet fruits and 2) nonsweet fruits. In our discussion of carbohydrates, we will limit our discussion primarily to the sweet fruits, even though the nonsweet fruits do contain some sugar.

For purposes of food combining for digestive compatibility, the sweet fruits can be divided into four groups: 1) sweet fruits, 2) subacid fruits, 3) acid fruits and 4) melons. The fruits in each category and how to combine them for best digestion will be discussed in a future lesson on correct food combining.

6. Why Starches Are Less Than Ideal Sources Of Carbohydrates

There are many reasons why starches are less than ideal as sources of carbohydrates for humans.

6.1 Many Digestive Steps Use More Body Energy

A larger amount of the body's limited supply of nerve energy is used up when starches are used for fuel than when fruits are used because starches are, as you know, polysaccharides and must be broken down (digested) into monosaccharides before the body can use them. Fruits contain a preponderance of monosaccharides, which, as you also know, need no digestion at all. Therefore, fruit eating leaves more of the body's energies available for other activities. This explains, in part, why people feel so "light" when they eat fruits and so heavy when they eat beans or bread.

6.2 There Is a Greater Tendency to Overeat on Starches

Because starches usually lack the amount of water content found in fresh fruits, it is much easier, to overeat on them than on fruits. It takes larger amounts of starch foods to get the same feeling of fullness that you get from a fruit meal. When starches are consumed, it is best to use only one kind of starch at a meal, as this helps control the tendency to overeat on starches.

6.3 Many Digestive Steps Take Longer and Fermentation Can More Readily Occur

For good digestion (an important prerequisite for good nutrition), not only do foods need to be

compatibly combined with one another, but they also need to be digested fairly quickly. As stated earlier, food that remains in the stomach too long will be decomposed by the bacteria that reside there.

The only starch-splitting enzyme secreted in the saliva, as previously stated, is ptyalin, also known as salivary amylase. The available amount of this enzyme is somewhat limited, and it is unlikely that large amounts of starch foods can be completely digested by salivary amylase, even if no proteins or acid foods are eaten with or too soon before or after the starches. Therefore, complete digestion of the starches eaten, especially if more than a very small amount is eaten or if they are eaten with protein or acid foods, is dependent upon the starch-splitting enzymes in the intestine—pancreatic amylase. However, the likelihood of indigested starches reaching the intestine without first fermenting in the stomach because of the action of bacteria there is rather small. Conditions of emotional or mental stress or anxiety, lack of sleep or rest, eating too fast or a digestive system weakened by years of past abuse are some of the reasons why fermentation may occur before undigested starches can reach the small intestine for digestion by the pancreatic amylase.

Fruits, on the other hand, if eaten with other fruits of like character, pass through the stomach very quickly into the intestine, where their monosaccharide content is rapidly and efficiently absorbed. Unless fruits are eaten with slower-digesting foods such as fat/protein foods (such as nuts, seeds or avocadoes) or starches, they are not likely to ferment in the stomach. Their need for almost no digestion makes it possible for the body to pass them through the digestive tract quickly, before fermentation by bacteria can occur.

6.4 Starches Are Poorly Digested Raw But Cooked Starches Are Unwholesome

Only very small amounts of raw starches can be digested because of the nature of the starch granule. Even the most thorough mastication of raw starches breaks open only a small fraction of the starch-containing globules, as each of these globules has a thin but strong protective cellulose covering which acts as a protective membrane for the plant's storage product (starch).

Neither salivary amylase (ptyalin) nor pancreatic amylase can commence digestion of the starch until it is released from its globule. These starch-containing globules are, therefore, not digested at all and must be eliminated from the body as so much debris. Undigested materials such as these are toxic in the body and pose an eliminative burden without providing energy or other value.

Cooking makes starches more digestible. As stated earlier, starches are not soluble in cold water and need to be heated to break down the cellulose coverings that surround starches. Heat also converts some of the starches to dextrins, and the more and longer heat is applied to the food, the greater will be the amount of starch that is converted to dextrins by this method. Undextrinized starches which have been freed by heat from their protective globules will be hydrolyzed (digested) by the salivary and pancreatic amylases. The resulting dextrins are large polysaccharide molecules that yield the disaccharide maltose upon hydrolysis. Maltose is, in turn, hydrolyzed into molecules of the monosaccharide, glucose.

Despite the greater digestibility of cooked starches, cooking is a very unwholesome process for many reasons, some of which were mentioned in previous lessons and more of which will be elaborated on in a future lesson dedicated to this subject. Basically, cooking destroys vitamins, partially or completely, depending on which vitamins are involved and how long and hot the cooking is; it converts minerals from their usable organic state back to their unusable (and therefore harmful) inorganic state; and it deranges (or deaminizes) the proteins present. (Starch foods do contain small amounts of protein, as protein is a component of all living matter.)

To summarize, while cooking might improve the digestibility of the starches in starch foods, it certainly does not improve the usability of the other nutrients and components of the food. On the contrary, it renders the minerals and proteins present at least partially toxic and unusable. Therefore, we recommend that neither raw starches nor cooked starches be included as part of an optimum diet.

In the case of legumes such as lentils and beans, however, there is one alternative: sprouting. The

starches in legumes are converted in the sprouting process at least partially to dextrins, which can be hydrolyzed by body amylases into the appropriate sugars. Grains which have not been processed (whole grains, in other words) can also be sprouted, but usually with less success because they often sour before their enzymes can complete the conversion of most of the starches to sugars.

The only starch foods we recommend are sprouted lentils, sprouted mung beans or sprouted azuke beans. A later lesson on food preparation will discuss sprouting in more depth.

6.5 Starches Are Usually Unpalatable Raw

Because we are physiologically fruit-eaters, most of us are not especially fond of nonsweet foods, at least not compared with how much we love sweet foods. We are not physiological starch eaters, and this is evidenced by our disinterest in foods such as raw potatoes, grains, beans, etc. Most starches just don't taste that good in their raw state.

Carrots, sweet potatoes and yams are notable exceptions, however, because these tubers, in addition to containing starches, also contain enough sugars to give them a sweet flavor. The main problem with eating these vegetables is that their sugars are likely to ferment in the stomach while they are held up there with the starches, which digest more, slowly than do the sugars. As stated earlier, sugars are normally passed swiftly through the stomach to the intestine for immediate absorption, but if they get held up in the stomach they ferment because of bacterial action. Carrots, sweet potatoes and yams may be used juiced, as long as they are eaten alone or about a half hour before a meal of compatible foods.

Some of us enjoy certain mildly starchy raw vegetables such as cauliflower and carrots. Eaten in moderate amounts, these vegetables are fine. Grated carrots and/or cauliflower flowerettes are nice additions to vegetable salads, but these salads should not contain nuts, seeds or tomatoes, which are poor combinations with even mild starches.

Remember: Although some starches can be sprouted or juiced, and others may be fine in moderation, especially if they're only mildly starchy, starches are, as a rule, unpalatable and indigestible raw and unwholesome cooked. As stated earlier, humans are not biologically adapted to starch eating.

6.6 Some Starch Foods Also Contain a Significant Amount of Protein

A future lesson on food combining will discuss in detail why it is unhealthful to consume starch foods and protein foods in the same meal. Basically, the two kinds of foods require very different digestive environments and enzymes, starch requiring ptyalin and an alkaline digestive environment, and protein requiring the enzyme pepsin and an acid digestive environment. Both foods cannot be digested simultaneously, and if eaten together or close to the same time, protein digestion will occur, at least partially, leaving the starches and sugars to ferment because of bacterial action in the stomach. Fermentative byproducts interfere with the protein digestion in progress, and protein digestion will most likely be incomplete. Undigested protein will putrefy (rot).

Most foods contain either a predominance of one factor or the other. For example, tubers and grains contain predominately starches, whereas nuts and seeds can be classified as protein/fat foods. But there are some foods which contain a lot of protein along with a lot of starch. Examples of some of these foods are beans of all types, peas and peanuts. Unless these foods are sprouted, which converts their starches to more easily digestible sugars, they are to a large extent indigestible. This is why beans are often referred to as the "musical fruit." They ferment and putrefy in the stomach and intestine, and this is an unwholesome occurrence because fermentation and putrefaction byproducts are toxins which must be eliminated as quickly as possible so that the body doesn't suffer great harm from them. Much body energy is used up in toxin elimination, energy that could be much more wisely used for other activities. Also, not all toxins are eliminated before some harm has resulted.

6.7 Wheat Poses Special Problems

Wheat is the most popular of the grains used in this country, especially commercially. But this popularity is undeserved because wheat poses special digestive problems that make it unwholesome. Basically, besides the digestive problems that wheat shares with the other starchy foods, the special problem with wheat is that it contains gluten, a protein substance that humans do not have the enzyme to digest. As you know, undigested substances are toxic in the human body and must be eliminated at a great expense of vital energy.

We might add at this point that beets are a mildly starchy root food that have a special problem: They contain too much oxalic acid which the body neutralizes by binding calcium. We recommend that you not use beets as an item of diet.

6.8 Grains and Legumes Are Acid-Forming

A later lesson will discuss in depth which foods are acid-forming and which are alkaline-forming and why we should have a predominance of alkaline-forming foods in our diet. Suffice it to say here that most grains and legumes are acid-forming and, for this reason, should be eaten in extreme moderation, if at all.

Grains contain phytic acid, a substance which binds calcium and iron, both in the grains themselves and the body stores of these minerals. This fact only complicates and aggravates the problem of calcium being taken from the bones and teeth by the body in the metabolism of carbohydrates that have been refined and their minerals, therefore, removed.

Anyone concerned about getting enough calcium should not eat grains. People who suffer with nervousness, sleeplessness and/or cramps may already be experiencing some of the symptoms of calcium deficiency. Getting carbohydrates from fresh fruits, and consuming dark green leafy vegetables, possibly along with a few occasional nuts, seeds and/or avocadoes, will insure adequate intake of usable calcium. Consuming grains in addition to the wholesome foods mentioned above is defeating of your purpose and is to be discouraged.

7. Why Fruits Are The Ideal Source Of Carbohydrates

Fruits are the ideal source of carbohydrates because they are the foods humans are physiologically and anatomically adapted to eating. (These adaptations will be discussed in greater depth in a later lesson.) Humans have a natural "sweet tooth" because that's our inherent nature. We're supposed to eat fruits, mostly sweet fruits. Incidentally, we can enjoy some nuts, seeds, vegetables and sprouts. But sugar-containing fruits should be the primary items in our diet.

The sugars in fruits, being mostly monosaccharides, pass through the stomach and are absorbed through the walls of the intestine without undergoing any digestion. This leaves a great surplus of body energy available for living and all the activities that make living a joy. We should not waste our precious energies digesting complicated, heavy foods unless it's a matter of life or death. Instead, we should eat simply of our natural foods—fruits—and use our energy for higher-level pursuits of life.

Fruits, except for dates and dried fruits, contain significant amounts of water in its purest and most delicious form. Therefore, they supply most, if not all, of our needs for water. Cooked starches, on the

other hand, are water-deficient and make us thirsty, especially if they're eaten with added salt or soy sauce and/or in very large amounts. Water is an extremely important need of life, and pure water as is in fruits is the only kind we should have. (Distilled water is also acceptable and is, in fact, the only kind of water we should obtain from nonfood sources. The subject of water will be treated in depth in a later lesson.)

Fruits do not have to be cooked or seasoned to taste great. In fact, they should never be cooked, though they can be dried for storage purposes. It is easy to make a meal on fruits, even mono-meals (just one fruit type at a meal), for other foods added to the fruit meal do not enhance it. Fruits are so delicious that they don't need enhancement and they digest so easily and quickly, eaten with each other or alone, that fermentation and the resulting toxicity of fermentation is unlikely to occur.

Since carbohydrates, quantitatively speaking, are the greatest nutrient need we humans have, it follows that fruits, loaded with sugars, should comprise the bulk of our diet. Fruits, besides being replete with ample carbohydrates, have relatively small amounts of proteins, vitamins and minerals—in just the right amounts for the specific needs of humans. If (anything other than fruits are eaten, it should be small amounts of nonsweet fruits, vegetables, nuts, seeds and sprouts.

8. Amounts And Variety Of Carbohydrates Needed By Humans

When most people think about amounts of carbohydrates to consume, they think in terms of calories—units for measuring heat. One calorie is the amount of heat required to raise the temperature of one kilogram of water one degree Centigrade. The amount of heat liberated by a complete breakdown of a food into its metabolic end products is expressed in calories.

For purposes of this course, however, calories are unimportant. Obtaining them is important, but numbers are not. Texts say that an average person needs a minimum of 1800 calories per day for just existing and more for any activities indulged. But, as mentioned in an earlier lesson, the variance is so great when it comes to individual needs, and people on conventional high-protein diets that include meat, etc., require so much extra energy to handle the constant input of toxins, causing an additional variance between "norms" and the actual needs of a truly healthy person, that the guidelines in the texts are practically useless. Besides, humans have always been able to get all the calories they need without counting them—and without even knowing about their existence.

So, in this section, we will take a more practical approach to the question of how much carbohydrate we need in our diet.

8.1 Amounts

Because protein, minerals and vitamins are present in sufficient quantities in carbohydrate foods to meet our needs for these nutrients, virtually the entire human diet can consist of carbohydrate foods (fruits). Some individuals, for various reasons, may find it desirable to include some protein/fat foods such as nuts, seeds and/or avocadoes and/or nonsweet fruits and/or vegetables in their diet of sweet fruits. However, if these foods are eaten, they should not be consumed with, immediately after or less than four hours before sweet fruits—to insure proper digestion of all foods involved and, specifically, to insure that the fruits pass quickly through the stomach to the intestine for absorption rather than getting held up by slower-digesting foods in the stomach and fermenting.

Whether an all-fruit diet is consumed, or other foods are included in the diet, the fact remains that an all-carbohydrate diet will amply supply not only all our energy (carbohydrate) needs, but it will also supply the proteins, fats, vitamins and minerals we need. (Fats are easily obtained by an occasional avocado, a nonsweet [oily] fruit.)

8.2 Variety

As far as food variety goes, foods grown on different soils in various locations will provide the broadest range of nutrients possible. Eating foods from one locale only, if not organically grown, could result in nutrient deficiencies, especially if only one or a few kinds of foods are consumed. This is probably not a concern for most people in the U.S., however.

While a diet consisting of a broad variety of wholesome natural foods may provide interest and a broad range of nutrients and nutrient combinations, it should be remembered that most foods to which we are biologically adapted contain most of the nutrients we need—in varying amounts. People worldwide have been known to live in excellent health on diets consisting of primarily or only one or a few foods. Some examples of such foods are coconuts, dates and bananas. There is much proof that a large variety of foods is not necessary for good health, though there is nothing to be said against variety, as long as the foods are wholesome, raw and correctly combined.

9. Disease Conditions Related To Carbohydrate Consumption

The following plus many more diseases are considered, by the medical world and by some lay people alike, to be either caused by or related to carbohydrates of various kinds in the diet. At this place in this course, we will not delve into any depth on these disease conditions, as they will be treated in separate later lessons. Here we will just briefly mention a few of the more common conditions related to carbohydrate consumption.

9.1 Lactose Intolerance

Humans, like the other mammals, provide milk for their young from their mammary glands. This milk is perfectly suited for the very specific needs of the developing human infant, but it is not designed to meet the needs of calves or kids or other baby mammals. It is meant for feeding human infants only. While the above statement may seem ridiculously obvious, it is not as obvious to many people that human babies should not receive milk from cows or goats except in emergencies where human milk is simply unavailable. In those exceptions, milk from another species of mammal is preferable to no milk at all.

The reason we introduce the subject of lactose intolerance the way we did in the above paragraph is to show two things: 1) how far we have strayed from nature in feeding cows' milk to our human babies and 2) that mammary milk is specially created for babies up to three years of age and is not designed for humans above that age.

The idea that we need calcium, fats, proteins or anything else from milk beyond the age of three is not only entirely false and totally ungrounded in fact, but it has caused a tremendous amount of harm and suffering for humans. "How did these ideas get started and popularized so widely, then?" you may ask. The simple but sad answer is that the, dairy industry is primarily responsible. (This entire subject will be treated in greater depth in a future lesson devoted entirely to the subject of milk and dairy products in

the diet.) As incredible as it may seem that so many people would actually put profit before human health, it is, nonetheless, true.

The problem of lactose intolerance is very widespread. The fact that from 18% to 100% of various peoples across the globe exhibit symptoms of lactose intolerance exemplifies the extent of the problems of consuming nature's formula for calves. Large numbers of people experience symptoms such as abdominal pain, diarrhea and flatulence (excessive formation of gas in the stomach or intestines). Many so-called allergies, skin disorders, so-called upper respiratory "infections," hay fevers and numerous other diseases—in fact, all diseases—are caused largely or to some extent by the toxic substances resulting from the inability of most (if not all) humans over age three to utilize the sugar, lactose, found in milk.

After age three, most, if not all, people do not secrete the enzyme, lactase, which is needed to break down the disaccharide, lactose, into the simple sugars, glucose and galactose. As you know, undigested sugars are fermented in the stomach and intestine by bacteria. However, it is not the bacteria that are causing the problem, for they are doing what their role in nature requires of them. The bacteria simply play their part in preparing the offending substance, in this case, lactose, for elimination from the body. The cause of the problem is the ingestion of food not appropriate for humans over three.

The solution is obvious and simple, but the powerful and influential dairy industry will do (and does) everything it can to keep this information a secret and to try to disprove it. Besides this, governments are on the side of industry, and individuals in government who can't be coerced to change are removed from positions that enable them to act in favor of human health.

It is a common misconception that the overall health of people is more dependent upon maintaining the jobs and industries that are now in operation than maintaining physical health. Too many people like to think that the connection between eating wrong foods and disease conditions of all kinds is only vague and questionable, when, in fact, the connection is very direct and the solution very simple. People like to think that some vitamin, some drug or some other kind of treatment will "cure" diseases and alleviate symptoms. Then they can go on indulging unhealthful practices and not disturb the status quo. But there is just no getting around the fact that, if we are to have better health, we must change our eating and living practices. No so-called "cures" or other treatments can even approach "making up for" healthful living. To try to do so is a futile effort. Change is really not so difficult if more people could just accept the idea that it is necessary and beneficial to everyone, both in the long run and in the short run.

To get back to the subject of lactose intolerance, can you see why most or all people do not digest lactose? Milk is not a natural or wholesome food for humans over age three; neither are other dairy products. While not everyone exhibits the clinical symptoms of lactose intolerance, the health of everyone suffers in some way as a result of milk consumption—if they drink milk or otherwise use milk or dairy products.

As stated earlier, the problems of milk and dairy products in the diet will be discussed in much greater depth in a future lesson on the subject.

One more item might be added here before we close this subject: Texts say that milk to which the enzyme lactase has been added and fermented dairy products are tolerated by lactose intolerant people. They list foods such as yogurt, buttermilk and cottage cheese. Suffice it to say here that all dairy foods are very unhealthful, including those listed above, and many symptoms other than those of lactose intolerance result from the consumption of unwholesome foods.

9.2 Galactosemia

Galactosemia is another disease condition related to milk, or lactose, consumption. This disorder, labeled "an unusual hereditary disorder," occurs in infants. Galactosemia is among the diseases that supposedly result from "inborn errors of metabolism." In this condition, a specific enzyme (p-galactose-uridyl-transferase) is lacking, so the infant cannot properly digest the sugars in milk. Specifically, the

monosaccharide galactose, which does not occur free in nature but results from the hydrolization of lactose from milk, cannot be converted to glucose.

Infants with this disorder vomit when they're fed milk and other dairy foods. They become lethargic and fail to gain weight. Their liver and spleen become enlarged (from overwork), cataracts develop and they become mentally retarded. In severe cases, death can occur. The solution to this problem is a milk- (and other dairy products) free diet, according to the texts. What is fed to babies instead of milk is not listed, but we would recommend freshly-made fruit juices in season, perhaps along with (at separate feedings, of course) homemade nut, seed or soy milk, depending upon the infant's tolerance to these. (The subject of care and feeding of infants and children will be treated in more depth in later lessons.)

9.3 Dental Caries

Dental decay is generally attributed to the consumption of too much sugar. However, the sugars in fresh ripe fruits, even in very sweet fruits such as dates and dried fruits, will never cause dental decay. The reason for this is that it is not sugar itself that causes cavities; rather, it is the consumption of refined sugars and other refined foods, such as refined flours and white or polished rice, that results in dental caries. The consumption of meats, dairy foods and other acid-forming foods in great excess of alkaline foods (fruits and vegetables in their raw state) is also an important contributing factor to dental decay.

As mentioned earlier in this lesson, calcium is needed in the metabolism of carbohydrates. Refined foods lack minerals, including calcium. The body is forced to draw calcium from its own reserves, and these reserves are depleted rather quickly if refined foods are eaten more than "once in a blue moon." If this occurs, the body must then draw the needed calcium from its bones and teeth—hence, cavities!

Meats and dairy foods, as well as whole grains, are acid-forming in the body. Calcium is needed to neutralize the acidity and maintain the normal blood alkalinity of 7.40 pH. After the calcium available in the body is used up, this mineral is taken from the bones and teeth.

As you can see, fruits are to be preferred over grains, meats, milk or dairy foods as sources of carbohydrates. Their sugars will not cause cavities, but fragmented foods (refined products) and unnatural foods (meats, milk, dairy, grains) will! From the standpoint of maintaining body calcium, the best choices of starch foods would be the tubers—potatoes, sweet potatoes, yams, and carrots.

No one ever need fear dental decay, even on a diet of sweet fruits. The important factor here is not to eat processed or refined foods or foods that are not suited to our biological adaptations. (The subject of sugar and other sweeteners will be treated in greater depth in a future lesson.)

9.4 Diabetes Mellitus

Much could be said about this disorder, but we'll treat it more thoroughly in a later lesson. At this point, suffice it to say that diabetes mellitus, defined as the insufficient production of insulin needed to metabolize sugar, has in common with dental caries the fact that it is caused by an unhealthful diet containing refined sugars, flours, grains and other unwholesome foods. Depending upon an individual's condition, special care and provision may have to be made for the diabetic who is going on the Life Science regime. Those using insulin, especially in very large amounts, should consult an experienced Hygienic professional before making very great changes in diet.

9.5 Hypoglycemia

This condition is also known as low blood sugar and is often a predecessor to diabetes. It, too, will be treated in depth in a future lesson, so we will say little about it here. True hypoglycemia is caused by the same things as cause diabetes. However, people are often diagnosed as hypoglycemic when, in fact, they just have a case of body toxicity. The symptoms of hypoglycemia are many and can also occur when a person is not actually suffering from this condition—hence, the incorrect diagnoses in many cases.

Contrary to popular opinion, most hypoglycemics can fast and benefit greatly by it. Since so many people suffer with this condition, this is good news indeed!

10. Questions & Answers

I was under the impression that the primary nutrient humans need is protein—for the maintenance of body cells. You say carbohydrates are our primary nutrient need. Why this discrepancy?

The discrepancy exists because our protein need has been overemphasized and our carbohydrate need underemphasized. In the field of nutrition, as in other fields, fads come and go. The excessive concern about obtaining adequate protein has so permeated the minds of most people that it has become a very dangerous preoccupation. It is dangerous because too much protein in the diet is very harmful and is the cause of much of the disease and suffering so many people are experiencing.

Why has our need for protein become so exaggerated? Why is our need for carbohydrates underestimated?
The meat and dairy industries, with the support of the government, are largely responsible for the "protein fashion." Their message has become a part of the public education systems—its textbooks, its universities, everything it teaches. They want us to believe that those foods which are most unhealthful, foods such as meat, fish, eggs, milk and cheese, are the most important part of our diet. Secondarily, carbohydrates from grains and breads are promoted—this mostly for the benefit of the refining and baking concerns that bring us Wonder Bread, Cheerios, Pop Tarts, etc. Fruits and vegetables are given very low priority, as the money to be made from marketing these foods is much less than from the nonperishable "foods" and the animal products.

Why have carbohydrates been underemphasized? For one thing, most people, being naturally attracted to sweet things (we are natural biological fruit eaters), manage to get more than enough carbohydrates in their daily diets. This is especially so when we consider the quantity of sugar (refined sugarcane or beets) in the average diet. Desserts, breads, pastas and cereals are quite popular, though these kinds of carbohydrates cause disease because of their nutritional lack of vitamins, minerals, fiber, water, etc., and for other reasons.

Also, a large number of people in our country are weight conscious, and carbohydrates have been named as the culprit. But excessive proteins are even worse than excessive carbohydrates! While weight may be lost on a high-protein/low-carbohydrate diet, the harm being done to the organism is more than the harm from keeping the excess fat. The key is to consume natural carbohydrates in the form of fresh fruits rather than processed products. Anyone desiring to lose weight can easily do so on an all-fruit or mostly-fruit diet—and gain excellent health while doing so. It's the quality of the carbohydrates consumed that makes the difference. Fresh fruits just don't cause people to gain weight, even if large amounts are eaten.

One more note on this subject: One physiology text condones the high-protein diet, even

though it states in the same chapter that carbohydrates are the most efficient fuel foods. The reasoning for this is that "adequate nutrition is possible ... if the need for calories, essential food factors, vitamins and minerals is met." Of course, they are referring to the body's ability to utilize proteins as carbohydrates if the intake of carbohydrates is insufficient. As you know, this is an extremely inefficient, wasteful process that is also harmful. The harm caused by excess protein and animal foods will be discussed in more depth in later lessons.

You spoke of losing weight on a fruit diet, but isn't it true that a person will gain weight on any kind of diet as long as the calories taken in are greater than the energy expended?

Yes, it is definitely true that a person will gain weight if they consume more calories than they expend. However, anyone who is serious about losing weight must pursue an exercise program of some sort. While a person can lose weight by dieting (or fasting) alone, the loss of excess fat must be accompanied by an improvement in overall health if it is to be worthwhile—and an exercise program is essential to good health, even if it's taken up after a fast.

Because fresh fruits contain much more water than other sources of carbohydrates, they provide satisfaction and a feeling of fullness after relatively few calories are consumed. (Of course, this is not true of dates or dried fruits, which should either be excluded from a weightloss diet or taken in moderation.) It is almost impossible to consume more calories than you expend on a fresh fruit diet—assuming you are active and get daily exercise. The subject of losing weight will be discussed in depth in a later lesson, also.

Is it possible for a person to gain weight on the diet you advocate?

Yes. Except in rare (relatively) cases where emaciation has occurred, gaining fat is usually not desirable. Many studies have shown that exceptionally lean people have longer lifespans and fewer diseases than people we would consider of "normal" weight. As a rule, lean is best. The important factor is the building of muscle, which can be done with the use of weights, along with a well-rounded exercise program (stretching exercises and aerobic exercises) or to a lesser degree without the use of weights. Body muscle can be developed in any number of ways—from swimming or running (or both) to calisthenics or tennis. Ideally, your program should include some resistance exercises (weights, push-ups, pull-ups, sit-ups, etc.), some aerobic activities and some stretching exercises, and should work all the body muscles. A truly attractive body is not one with five or ten pounds of extra fat, but one that is firm and filled out by normal musculature.

For those people who are emaciated and do need to gain fat, this should not be rushed. In addition to obtaining generous amounts of exercise (as outlined briefly above), the excessively thin person should make sure his or her life is not too stressful. Also, he or she should consider a fast if there is a chance that adequate calories have been consumed but the body is unable to use them. A physiological rest may be needed more than tremendous amounts of food in this case.

When it comes to eating, people of all body weights should eat normal amounts of healthful foods. Weight gain or loss is a body activity that will occur naturally if we provide the normal and proper conditions of life. Gaining or losing weight is not something we do; rather, it is something the body does. We just provide our needs, and the organism will normalize itself.

Feeding the people in the United States and in the world would not be possible without the food processing industries. There wouldn't be enough fresh fruits to feed everyone. The diet you

propose is totally impractical. How do you answer to this?

I'm glad you asked that question! The food processing industries are not in business to see that a larger amount of food is available to the world's people. Rather, they are in business to make money. Everyone would be better fed, even on a diet of grains, which is very inferior to the fruit diet, if they were consumed in their whole form rather than processed. Foods are more nutritious before they are processed, so people would be healthier if it weren't for these industries.

The food processing industries do not increase the quantity of food available, either. It is the food growers (farmers and orchardists) who insure that people get enough food. The following topic will be discussed in depth in later lessons, but here we will say that fruit culture and organic gardening could feed the world's population more than adequately if the money and labor now used for food processing (destruction) was instead used for growing fruits and vegetables by organic means. This would, of course, have to happen at least somewhat gradually, but it is possible if enough people agreed to it. The whole world could become The Garden! Wouldn't orchards and vineyards of fruit and nut trees be more appealing to the senses in every way than food refining plants and factories? People's health could improve so much that the drug industry could also divert it's money and labor to healthful endeavors. Hospitals could be turned into schools, hotels, gyms! As you can see, the possibilities are enormous— and exciting!

No, our natural diet is far from impractical. The earth is perfectly equipped for the growing of fruit and nut trees and vegetables. Food could also be supplied to those areas where little or no food can be grown in some seasons by using money and manpower for effective food distribution. Nuts, seeds, dates, dried fruits and seeds and beans for sprouting all ship and store relatively well.

I and many other people have more regular bowel movements because we include bran in our diet. Would you consider this a fairly wholesome part of some people's diet because of its anti-constipation effect?

Absolutely not! Bran is a food fragment; that is, it is only part of the whole wheat berry. It has many sharp edges which irritate and cut the delicate tissues within the gastrointestinal tract. Humans require their carbohydrate in the form of usable sugars—not in the form of indigestible cellulose.

As far as regular bowel movements go, you will definitely have them on a diet consisting primarily of the foods of our biological adaptation—fresh fruits. It is not for you, me or anyone else to decide how large or how frequent our bowel movements should be—this is strictly a body process that should remain entirely on a subconscious level. We should never have to think about it at all, let alone talk about it. And on the proper diet, you can be sure that everything is happening as it should within your body, for, as you know, the inherent intelligence of your body is great. Our only responsibility is to provide the normal needs of life—and then just live. The body will take care of its own needs.

I'm hypoglycemic. There's no way I could ever go on the fruit diet you advocate. I can get my carbohydrates from starch foods, can't I?

Yes, you can get your carbohydrates from starch foods. Because of the special problems of such starches as grains (phytic acid; their acid effect), beets (oxalic acid, which binds calcium) and beans (also contain much protein, which makes them digest very poorly), you should stick to lightly-steamed potatoes, yams, cauliflower, carrots and sweet potatoes rather

than using grains, beans or beets. They can also be eaten raw or juiced if you like. You may include sprouted seeds and beans, such as chick peas (garbanzos), dry peas, mung beans, alfalfa seeds, etc., as well as lots of vegetables and non-sweet fruits and some nuts, seeds and avocados in your diet. However, do not overdo on the oily foods (nuts, seeds, avocados). Rice and millet are the best of the grains, and can be used in moderation, especially with large raw vegetable salads that contain vegetables such as lettuce, broccoli, cabbage, kale, celery, etc., but that do not contain nuts, seeds, avocados, tomatoes or starch foods. (The rice or millet is sufficient starch for one meal.) Other relatively wholesome starch foods you may want to consider to insure more variety (if variety is important to you) are winter squashes, pumpkins, caladium roots, taro roots, cassava roots and Jerusalem artichokes. Rutabaga and salsify are also wholesome starch foods. (You may not be able to obtain some of the foods listed above, but keep your eyes and ears open.)

Keep in mind that starches are not ideal foods for humans, even hypoglycemic humans. Starches remain second-rate sources of carbohydrates. For best results in using them, use just one kind of starch food at a given meal and follow correct food combining rules (as briefly explained in this section, but to be discussed in greater depth in a later lesson) and chew your food well. Also, refrain from drinking anything during or within 2-3 hours after your meals. Understand that you cannot obtain optimum health on a diet consisting of cooked starches as your primary source of carbohydrates.

I recommend that, as soon as possible, you take a supervised fast. Hypoglycemics can and do fast—and with excellent results. Many can return to a normal diet that includes lots of fruits. Most or all can include fruits as a substantial part of their diet, though their intake of the very sweet fruits such as dates, dried fruits and persimmons may be restricted. Some fruits contain much less sugar than others and can be tolerated well by "recovering hypoglycemics."

Whether you fast or not, if you begin living and eating more healthfully, you will be able to eat some fruits, at least in moderation, right away or very soon. As your body begins to normalize and gets rid of stored up toxins that contribute to your problem, you will be able to consume a larger and larger proportion of fruits in your diet. A hypoglycemic does not have to remain hypoglycemic forever. Health results from healthful living—so live healthfully and you will get well.

Article #1: Carbohydrates by Dr. Herbert M. Shelton

The following segment on carbohydrates was written by Dr. Herbert M. Shelton in his book, Orthotrophy in a chapter on food elements.

This is the name given to certain organic compounds of carbon that are produced by plants in the process of growth from carbon, hydrogen and oxygen, with the oxygen and hydrogen in proportions to form water. In everyday language we know the most important of these carbohydrates as starches and sugars. As will be seen later, carbohydrates are complex substances composed, in most instances, of

simpler substances, or building blocks, called sugars. Chief among the carbohydrates are:

Fruits—Bananas, all sweet fruits, hubbard squash, etc.

Nuts—A few varieties—acorns, chestnuts and coconuts.

Tubers—Potatoes, sweet potatoes, carrots, artichokes, parsnips, etc.

Legumes—Most beans, except some varieties of soybeans, all peas, peanuts.

Cereals—All grains and practically all cereal products. (Gluten bread is not a carbohydrate.)

Grains and legumes are classed both as proteins and carbohydrates. This is due to the fact that they contain enough of each of these food elements to be placed in both classes. Nuts, for the same reason, are classed both as proteins and as fats. Milk, commonly classed as a protein, is really low in protein. It may with equal justification be classed as a sugar or carbohydrate. All foods contain more or less carbohydrates, as they all contain more or less protein. Most foods contain some fats, but there is none in most fruits nor in the green leaves of vegetables.

Carbohydrates, like proteins, are composed of simpler compounds known as simple sugars or monosaccharides. According to their composition, these are classed as follows:

1. *Monosaccharides*: Sugars containing only one sugar group or radical. Among the monosaccharides are grape sugar (glucose or dextrose), fruit sugar (fructose or levulose) and galactose of honey. These are the assimilable forms of carbohydrate. Dextrose is the principle member of the glucose group and much less sweet than cane sugar. It is known as grape sugar and is found in fruits, some vegetables and honey. Glucose occurs in both plants and animals and is formed by the action of heat and the ultraviolet rays upon starch in the presence of an acid. Corn syrup is commercially known as glucose. Glucose may also be made by treating starch with sulphuric acid in the presence of heat.
   Fructose and levulose are derived from fruits and honey. Galactose is a crystaline glucose obtained by treating milk sugar with dilute acids.
2. *Disaccharides*: Sugars containing two simple sugars, or that can be broken into two monosaccharides. The ordinary cane sugar or sucrose of commerce is a disaccharide composed of glucose and galactose. Invert sugar found in honey is a mixture of glucose and fructose. Maltose of malt sugar is composed of galactose and glucose. Maple sugar (sucrose) and milk sugar (lactose) are also disaccharides.
3. *Trisaccharides*: Sugars containing three sugar groups or radicals. Beet sugar is the best known example of this sugar.
4. *Polysaccharides*: Colloids or noncrystalizable organic substances known as starches. There are three main groups of polysaccharides: 1) starches; 2) glycogen (animal starch) and 3) pentosans. Pentosans are numerous and include the cellulose or woody fibre of cotton, linen, walls of plant cells, etc. They are usually indigestible, although, in tender cabbage and other very tender vegetables, they are digestible. Galactose found in sugar, seeds, and algae; pectins found in unripe fruit and the gummy exudate on trees and plants are also pentosans.

Starches and sugars are well known to everyone, as they are found in all fruits and vegetables. Sugars are soluble carbohydrates with a more or less sweet taste. When heated to a high temperature they form caramel. Sugars are crystalloids; starches are insoluble and are colloids. Glycogen and milk sugar are the only carbohydrates of animal origin and even these are derived originally from the plant. Animals are incapable of extracting carbon from the air and synthesizing carbohydrates.

While the sugars are all soluble, raw starch is insoluble. Boiling will render part of it soluble. This, however, hinders its digestion. Starch is converted into a disaccharide in the mouth, and this is converted into a monosaccharide in the intestine.

The body cannot use starch. It must first be converted into sugar before it can be utilized by the cells.

This is done in the process of digestion and begins in the mouth. Disaccharides and polysaccharides are converted into monosaccharides in the process of digestion, as carbohydrates can be absorbed and assimilated only as monosaccharides. Starch must first be converted into sugar, and the complex sugars must be converted into simple sugars before they are absorbed. The body's need for sugar may easily be supplied without eating commercial sugars and syrups or any form of denatured carbohydrate. Child and adult alike should eat only natural sweets and starches.

Sugar is the most important building material in the plant world. A characteristic difference between plants and animals is that, whereas the animal is built up largely out of proteins, the plant is built up largely out of carbohydrates. Plants may be truly said to be made of sugar. They contain various minerals and some nitrogen, but practically the whole fabric of the plant or tree is composed of sugar in some form. Sugars are essential constituents of all plants without which they cannot exist. Indeed, sugars are the most important and most abundant building materials in plants. Out of the *immature* or *sap sugars*, plants build their roots, stems, flowers, fruits and seeds. The finished plant is almost literally made of sugar.

Nature produces sugars out of three gases—carbon, oxygen and hydrogen. Oxygen and hydrogen in proportions to form water are taken from the water in the soil. Carbon is taken from the carbon dioxide of the air. Out of these gases, or out of this fluid and gas, the plant synthesizes sugar, a thing the animal cannot do. The green coloring of plants is due to the presence of a pigment known as chlorophyll. This pigment takes part in a chemical process known as photosynthesis, by which carbon dioxide (or at least the carbon in the carbon dioxide), with the aid of sunlight, is united with water to form sugar. Recent experiments have shown that enzymes contained in the leaves of the plants are the chief agents in the production of this sugar. Some plants can produce sugar in the absence of light.

Not only the starches of plants, but also the pentosans, the woody fibers, cellulose and gums are made of sugar and may be reconverted into sugar. When carbohydrates are stored for long periods, they are stored as starches. When they are used, they are reconverted into sugars. Corn, peas, etc., are sweet (full of sugar) before they mature. The sap of the corn is also sweet. The sap of the cane plant is very sweet. In the matured state corn, cane seed and peas are hard starch grains. In the germinating process the starch is reconverted into sugar. As starches these seeds will keep for long periods of time; as sugars they would not keep until the following spring. It will be noticed that the enzymes in seeds do not require ultraviolet rays and acid to bring about this reconversion, any more than do the enzymes in digestive juices.

Fruits are ready for immediate use and, if not used soon after ripening, tend to decompose rapidly. Grains are intended for storage. It is significant that fruits are composed of insoluble starches and are usually rich in acids before they ripen. In this state they are usually avoided by animals. The starch is reconverted into sugar in the ripening process. This arrangement protects the seed of the fruit until it is matured and ready for dispersal. Then the fruit is ripened and made ready for food.

The animal, like the plant, builds its carbohydrates out of sugar. All starch foods must be converted into sugar (in the process of digestion) before they can be taken into the body and used. Animal starch (glycogen) is made from sugar. It, like the starch of grains, is a storage product. Like the starch of grains, it must be reconverted into sugar before using. The sugar in milk may be made from starches.

The matured fruit sugars of plants, especially those of fruits, are particularly appropriate for food. They are never concentrated and are always well balanced with other nutrients. They are built up out of the immature sugar and impart to both fresh and dried fruits their delicious flavors. Matured sugars in flowers are collected by bees and made into honey. Fruit sugars are, in truth, export products produced by plants.

All the sugar the body requires may be obtained from fresh ripe fruits. This is especially so during the summer months. During the winter months when fresh fruits are not so abundant, dried (but unsulphured) fruits are excellent sources of sugar. These should not be cooked. Owing to the absence of water, dried fruits are more concentrated foods than fresh fruits and should not be eaten in the same

bulk.

Just as fruits are savoured with their matured sugars, so vegetable foods are savoured with the immature juices (saps) of the plants. In the plants, as in the fruits, the sugars are combined with vitamins, mineral salts, fiber and other elements of foods.

It is essential to emphasize that sugars constitute but one of the ingredients of plant life and are never put up in their pure state. In fruits and plants they are always combined with and balanced by other ingredients, particularly with salts, vitamins and water. Man, not nature, produces concentrated sugars. Man, not nature, separates the minerals from sugar. Sugars should be eaten as nature provides them.

Commercial syrups and molasses are concentrated saps. Besides being concentrated, usually by the use of heat in evaporating the water, they are deprived of their minerals and vitamins and have preservatives, artificial colors and flavors added and are often bleached with sulphur dioxide, with which they become saturated. Commercial sugars—maple, cane, beet, milk—are crystalized saps. They, too, are unbalanced, commonly bleached and thoroughly unfitted for use. So concentrated are these syrups and sugars, so denatured and so prone to speedy fermentation in the digestive tract, that it is best not to employ them at all. If they are used, they should be used very sparingly. The same rule should apply to honey. This food of the bee contains all the other nutritive elements in very minute quantities, being largely water and sugar with flavors from the flowers. If it is eaten, it should be taken sparingly.

What a difference between eating sugar cane and eating the extracted, concentrated and refined sugar of the cane! It is said that it takes a West Indian native an hour to chew eighteen inches of cane from which he derives the equivalent of one large lump of sugar—less than the average coffee-drinker puts into a single cup of his favorite poison. (The boys and girls of Texas and Louisiana can chew sugar cane faster than the West Indian native, it seems.) In thus securing his sugar, the cane eater secures the minerals and vitamins that are normally associated with sugars—he does not eat a "purified" product.

Sugar is regarded as an energy food, but it is a remarkable fact that the heavy sugar eater prefers to watch athletic games to taking part in them. We, of course, have reference to the heavy eater of commercial sugars. They seem to stimulate and then depress the muscular powers.

It has long been the Hygienic theory that the catarrhal diseases are based on carbohydrate excess—sugar excess, as all starches are converted into sugar in digestion. It is interesting to note, in this connection, that the *British Medical Journal* for June 1933 carried an article discussing "the relation of excessive carbohydrate ingestion to catarrh and other diseases," in which it was pointed out that during World War I, the incidence of catarrhal illnesses was reduced seemingly corresponding with the great eduction of sugar consumption. The writer of the article concludes that "restriction in the use of sugar would result in improvement in the national health as regards catarrhal illness, as well as in other directions."

Article #2: Digestion Of Foods by Dr. Herbert M. Shelton

Foodstuffs as we eat them constitute the raw materials of nutrition. As proteins, carbohydrates and fats, they are not usable by the body. They must first undergo a disintegrating, refining and standardizing process (more properly a series of processes) to which the term digestion has been given. Although this process of digestion is partly mechanical, as in the chewing, swallowing and "churning" of food, the physiology of digestion is very largely a study of the chemical changes foods undergo in their passage through the alimentary canal. For our present purposes, we need give but little attention to intestinal digestion but will concentrate upon mouth and stomach digestion.

Enzymic Limitations Necessitate the Combining of Compatible Foods

The changes through which foods go in the processes of digestion are affected by a group of agencies known as enzymes. Due to the fact that the conditions under which these enzymes can act are sharply defined, it becomes neccessary to give heed to the simple rules of correct food combining that have been carefully worked out on a basis of the chemistry of digestion.

Long and patient effort on the part of many physiologists in many parts of the world have brought to light a host of facts concerning enzymic limitations, but, unfortunately, these same physiologists have attempted to slur over their importance and to supply us with fictional reasons why we should continue to eat and drink in the conventionally haphazard manner. They have rejected every effort to make a practical application of the great fund of vital knowledge their painstaking labors have provided. Not so the Natural Hygienists. We seek to base our rules of life upon the principles of biology and physiology.

What Enzymes Are

Let us briefly consider enzymes in general before we go on to a study of the enzymes of the mouth and stomach. An *enzyme* may be appropriately defined as a physiological *catalyst*. In the study of chemistry it was soon found that many substances that do not normally combine when brought into contact with each other may be made to do so by a third substance when it is brought into contact with them. This third substance does not in any way enter into the combination or share in the reaction; its mere presence seems to bring about the combination and reaction. Such a substance or agent is called a *catalyst* and the process is called *catalysis*.

Plants and animals manufacture soluble catalytic substances, colloidal in nature and but little resistant to heat, which they employ in the many processes of splitting up of compounds and the making of new ones within themselves. To these substances the term *enzyme* has been applied. Many *enzymes* are known, all of them, apparently, of protein character. The only ones that need interest us here are those involved in the digestion of foodstuffs. These are involved in the reduction of complex food substances to simpler compounds that are acceptable to the bloodstream and usable by the cells of the body in the production of new cell substance.

Bacterial By Products Poisonous

As the action of enzymes in the digestion of foodstuffs closely resembles fermentation, these substances were formerly referred to as ferments. Fermentation, however, is accomplished by organized ferments—bacteria. The products of fermentation are not identical with the products of enzymic disintegration of foodstuffs and are not suitable as nutritive materials. Rather, they are poisonous. Putrefaction, also the result of bacterial action, also gives rise to poisons, some of them very virulent.

Digestive Enzymes Extremely Specialized

Each enzyme is specific in its action. This is to say, it acts only upon one class of food substance. The enzymes that act upon carbohydrates do not and cannot act upon proteins nor upon salts nor fats. They are even more specific than this would indicate. For example, in the digestion of closely related substances such as the disaccharides (complex sugars), the enzyme that acts upon maltose is not capable of acting upon lactose. Each sugar seems to require its own specific enzyme. The physiologist, Howell, tells us that there is no clear proof that any single enzyme can produce more than one kind of ferment action.

Digestion a Step-By-Step Process

This specific action of enzymes is of importance, as there are various states in the digestion of foodstuffs, each state requiring the action of a different enzyme and the various enzymes being capable

of performing their work only if the preceding work has been properly performed by the enzymes that also precede. If *pepsin*, for example, has not converted proteins into peptones, the enzymes that convert peptones into amino acids will not be able to act upon the proteins.

The substance upon which an enzyme acts is called a *substrate*. Thus starch is the substrate of *ptyalin*. Dr. N. Phillip Norman, Instructor in gastroenterology, New York Polyclinic Medical School and Hospital, New York City, says: "In studying the action of different enzymes, one is struck by Emil Fischer's statement that there must be a special key to each lock, the ferment being the lock and its substrate the key, and if the key does not fit exactly in the lock, no reaction is possible. In view of this fact, is it not logical to believe the admixture of different types of carbohydrates and fats and proteins in the same meal to be distinctly injurious to the digestive cells? If, since it is true that similar but not identical locks are produced by the same type of cells, it is logical to believe that this admixture taxes the physiological functions of these cells to their limit?" Fischer, who was a renowned physiologist, suggested that the specificity of the various enzymes is related to the structure of substances acted upon. Each enzyme is apparently adapted to or fitted to a certain definite structure.

Chewing Is First Digestive Step

Digestion commences in the mouth. All foods are broken up into smaller particles by the process of chewing, and they are thoroughly saturated with saliva. Of the chemical part of digestion, only starch digestion begins in the mouth. The saliva of the mouth, which is normally an alkaline fluid, contains an enzyme called *ptyalin*, which acts upon starch, breaking this down into maltose, a complex sugar, which is further acted upon in the intestine by maltase and converted into the simple sugar *dextrose*.

The action of ptyalin upon starch is preparatory, as maltase cannot act upon starch. *Amylase*, the starch-splitting enzyme of the pancreatic secretion, is said to act upon starch much as does *ptyalin*, so that starch that escapes digestion in the mouth and stomach may be split into maltose and achroodextrin, providing, of course, that it has not undergone fermentation before it reaches the intestine.

Some Enzymes Destroyed By Acids and Alkalines

Ptyalin is destroyed by a milk acid and also by a strong alkaline reaction. It can act only in an alkaline medium, and this must not be strongly alkaline. It is this limitation of the enzyme that renders important the manner in which we mix our starches, for if they are mixed with foods that are acid or that provide for an acid secretion in the stomach, the action of the ptyalin is brought to an end.

Some Factors That Inhibit Digestion

Stomach (gastric) juice ranges all the way from nearly neutral in reaction to strongly acid, depending upon the character of the food eaten. It contains three enzymes-pepsin, which acts upon proteins; lipase, which has slight action upon fats; and rennin, which coagulates milk. The only one of these enzymes that needs concern us here is pepsin. Pepsin is capable of initiating digestion on all kinds of proteins. This is important, as it seems to be the only enzyme with such power. Different protein splitting enzymes act upon the different stages of protein digestion. It is possible that none of them can act upon protein in stages preceding the stage for which they are specifically adapted. For example, erepsin, found in the intestinal juice and in the pancreatic juice, does not act upon complex proteins, but only upon peptides and polypeptides, reducing these to amino acids. Without the prior action of pepsin in reducing the proteins to peptides, the erepsin would not act upon the protein food. Pepsin acts only in an acid medium and is destroyed by an alkali. Low temperature, as when iced drinks are taken, retards and even suspends the action of pepsin. Alcohol precipitates this enzyme.

Just as the sight, odor or thought of food may occasion a flow of saliva, a "watering of the mouth," so these same factors may cause the flow of gastric juice, that is a "watering of the stomach." The taste of food, however, is most important in occasioning a flow of saliva. The physiologist, Carlson, failed in

repeated efforts to occasion a flow of gastric juice by having his subjects chew on different substances, or by irritating the nerve endings in the mouth by substances other than those directly related to food. In other words, there is no secretory action when the substances taken into the mouth cannot be digested. There is selective action on the part of the body and, as will be seen later, there are different kinds of action for different kinds of foods.

In his experiments in studying the "conditioned reflex," Pavlov noted that it is not necessary to take the food into the mouth in order to occasion a flow of gastric juice. The mere teasing of a dog with savory food will serve. He found that even the noises or some other action associated with feeding time will occasion a flow of secretion.

It is necessary that we devote a few paragraphs to a brief study of the body's ability to adapt its secretions to the different kinds of foodstuffs that are consumed. Later we will discuss the limitations of this power. McLeod's *Physiology in Modern Medicine* says: "The observations of Pavlov on the responses of gastric pouches of dogs, to meat, bread and milk have been widely quoted. They are interesting because they constitute evidence that the operation of the gastric secretory mechanism is not without some power of adaptation to the materials to be digested."

Digestion Proceeds Intelligently

This adaptation is made possible by reason of the fact that the gastric secretions are the products of about five million microscopic glands embedded in the walls of the stomach, various of which secrete different parts of the gastric juice. The varying amounts and proportions of the various elements that enter into the composition of the gastric juice give a juice of varying characters and adapted to the digestion of different kinds of foodstuffs. Thus the juice may be almost neutral in reaction or it may be weakly acid or strongly acid. There may be more or less pepsin according to need. There is also the factor of timing. The character of the juice may be very different at one stage of digestion from what it is at another, as the varying requirements of a food are met.

A similar adaptation of saliva to different foods and digestive requirements is seen to occur. For example weak acids occasion a copious flow of saliva, while weak alkalies occasion no salivary secretion. Disagreeable and noxious substances also occasion salivary secretion, in this instance to flush away the offending material. It is noted by physiologists that with at least two different types of glands in the mouth able to function, a considerable range of variation is possible with reference to the character of the mixed secretion finally discharged.

An excellent example of this ability of the body to modify and adapt its secretions to the varying needs of various kinds of foods is supplied us by the dog. Feed him flesh and there is a secretion of thick, viscous saliva, chiefly from the submaxillary gland. Feed him dried and pulverized flesh, and a very copious and watery secretion will be poured out upon it, coming from the parotid gland. The mucous secretion poured out upon flesh serves to lubricate the bolus of food and thus facilitate swallowing. The thin, watery secretion, on the other hand, poured out upon the dry powder washes the powder from the mouth. Thus, it is seen that the kind of juice poured out is determined by the purpose it must serve.

Humans Ate Correctly In Nature

As we previously noted, ptyalin has no action upon sugar. When sugar is eaten there is a copious flow of saliva, but it contains no ptyalin. If soaked starches are eaten, no saliva is poured out upon these. Ptyalin is not poured out upon flesh or fat. These evidences of adaptation are but a few of the many that could be given. It seems probable that a wider range of adaptation is possible in gastric than in salivary secretion. These things are not without their significance to the person who is desirous of eating in a manner to assure most efficient digestion, although it is the custom of physiologists to gloss over or minimize them.

There are reasons for believing that man, like the lower animals, once instinctively avoided wrong

combinations of foods, and there are remnants of the old instinctive practices still extant. But having kindled the torches of intellect upon the ruins of instinct, man is compelled to seek out his way in a bewildering maze of forces and circumstances by the fool's method of trial and error. At least this is so until he has gained sufficient knowledge and a grasp of proved principles to enable him to govern his conduct in the light of principles and knowledge. Instead, then, of ignoring the great mass of laboriously accumulated physiological knowledge relating to the digestion of our foodstuffs, or glossing over them as is the practice of the professional pysiologists, it behooves us, as intelligent beings, to make full and proper use of such knowledge. If the physiology of digestion can lead us to eating practices that insure better digestion, hence better nutrition, only the foolish will disregard its immense value to us, both in health and in disease.

Article #3: Starches Are Second-Rate Foods by Marti Fry

Have you noticed how often we state that fruits are the foods to which we are biologically suited? We rank them as first-class foods and we rank starchy foods such as tubers, legumes and grains as second- or third-class foods. One reason for this, as you may know, is that most starchy foods have to be cooked to make them tasty. Of course there are exceptions to this:

1. Some people like potatoes, yams, etc., raw.
2. Some mildly starchy vegetables such as carrots, peas and cauliflower are palatable in the raw state to most people.
3. Many legumes can be sprouted instead of cooked.

But despite these exceptions, starchy foods are not ideal for humans. Unlike sugars from fruits, which pass almost directly from the stomach to the small intestine for absorption, starches must be converted to sugar for the body to unlock their energy potential.

Most animals secrete starch-splitting enzymes called amylases, derived from the Latin word meaning—you guessed it—*starch-splitting*. In humans, starch digestion begins in the mouth: Our saliva contains an amylase called ptyalin, from the Greek word *ptyalon*, meaning *saliva*. Ptyalin, also called salivary amylase, changes starch chemically into maltose, a complex sugar.

Many other animals, such as pigs, birds and other starch eaters, but not humans, secrete other additional amylases to insure complete starch digestion. To be sure bf adequately digesting the starch we humans consume, we must chew our food very, very thoroughly so it becomes well-mixed with saliva.

The starch that's converted to maltose by salivary enzymic action is further broken down in the small intestine by the enzyme maltase into the simple sugar, dextrose, for the bloodstream can absorb only simple sugars, never starches or complex sugars. (Dextrose is dextrorotatory glucose.)

Only 30 to 40 percent of the starch eaten can be broken down by ptyalin in the mouth. If starches are eaten with (or close in time to ingestion of) acid fruits (citrus fruits or tomatoes) or with protein foods, the ptyalin in the saliva that's swallowed with the food cannot further break down the starch into simple sugars.

This is because ptyalin can only act in an alkaline environment and the stomach environment becomes acid when proteins are consumed. The acids in fruits will also inhibit the secretion of ptyalin. Hence, you should take care to eat starchy foods (if you eat them at all) with vegetables and not with acid or protein foods to insure the best possible digestion.

We do secrete a pancreatic amylase in our intestine to digest starches not handled by salivary amylase (ptyalin). But starches, often partially decompose in the stomach before they get to the intestine.

In addition, *there's a problem relative to human starch digestion* and this is another reason why starches are usually cooked or sprouted (besides for taste):

According to *The Textbook of Medical Physiology* by Arthur C. Guyton, M.D.:

> *Most starches in their natural state, unfortunately, are present in the food in small globules, each of which has a thin protective cellulose covering. Therefore, most naturally-occurring starches are digested only poorly by ptyalin unless the food is cooked to destroy the protective membrane.*

If cooking can destroy the protective membrane around the starch cells, what is it doing to the food's value? Cooking changes the minerals and proteins into unusable forms and destroys most vitamins!

Chewing only partially damages the protective covering of starch globules and so raw starches can only be partially digested. While undigested foods cause pathogenic problems in the human body, the toxins ingested when we eat cooked foods (deranged vitamins and minerals) cause even greater problems.

In light of how the human body uses starches by changing them to simple sugars through a complicated and only partially effective process, why not consider getting all your carbohydrate needs from fresh fruits which are already in the form of simple easily-digestible sugars? We don't need starches at all and can thrive more healthfully without them.

This article is reprinted from *The Health Crusader*, *Better Life Journal*'s predecessor.

Article #4: The "Staff Of Life" by Marti Fry

We have stated many times that wheat and bread are unwholesome foods for several reasons: Wheat, the seed of cereal grass, is a starchy food that the body cannot digest properly and fully because we secrete only a limited amount of ptyalin, the enzyme that starts digestion of starches, and we secrete no enzyme to break down gluten. Also, wheat and breads are almost always eaten with sugars and/or proteins, all of which then end up in producing indigestion and pathogenic conditions inside the body.

Unless you sprout whole wheat berries, wheat must be cooked to be eaten; and cooking renders the food's nutrients mostly unusable and quite toxic. Whole wheat flour, even if freshly ground, lacks in nutritional value because of the great loss of nutrients due to oxidation of the burst food cells.

Despite these convincing reasons why we shouldn't eat bread at all let's talk about bread a bit further. The wheat bread sold in stores is likely to be only 25 percent wheat, the other 75 percent of the flour being bleached white flour. But you can't tell this by just looking at the bread, for it may be colored with caramel to make it look darker like 100 percent whole wheat bread. The label has to say "whole-wheat flour" or else it's only partly whole wheat.

This is bad enough but there's worse news: The high-fiber breads that are becoming so popular these days contain powdered cellulose, a cheap byproduct of the paper industry. Even nonhygienic minded "health" writers warn against consuming artificial fiber.

The paper mills are selling this powdered cellulose to food processors as a "bulking agent" for cookies, cakes, pastas and breakfast cereals, as well as for bread. The human body wasn't designed to digest this

waste product of the paper industry. Your best bet is still to stay away from products which contain "bulking agents," sugar or honey, salt, preservatives, colorings and wheat.

Article #5: What's Wrong With Wheat by Marti Fry

Most people think that whole grain breads are the "staff of life"—that we need to eat bread to be healthy. However, this has been found to be untrue. Even 100 percent whole wheat is unhealthful. Many doctors have their patients merely eliminate grain products (including whole wheat bread) from their diets because this helps many people lose weight.

Medical research has proven that wheat is one of the causes of colds. Families were asked to give up bread and grains for one year. What happened was that no one in these families suffered any colds that year. Another study has shown that wheat is a main contributor of eczema, hives, migraine headaches and various "allergies."

Of course we know wheat is an *indirect* cause of diseases; that is, it is usually cooked and otherwise processed such that it contributes to body toxicity. This starchy food is almost always combined improperly; that is, it is eaten with honey, sugar or fruit as in breads, pies, fruitcakes, cereals, etc., or with protein foods such as meat, cheese, milk, yogurt, nuts, seeds, etc.

Consequently, poisonous byproducts of indigestion are created in the stomach. The toxins resulting from fermentation (starch) or putrefaction (proteins) accumulate with other toxins and bring toxemia, the sole cause of disease.

A research undertaken by Dr. Alvarez of the Mayo Clinic states, "Bread can pass though the whole of the small intestine without being digested at all!" Also, wheat interferes with the absorption of other foods, as does salt. Life Scientists know that years of eating wrong combinations of wrong foods gradually impair the body's digestive abilities.

When people eat a lot of bread they get filled up. Thus they eat less of the fruits and vegetables that have the proper nutrient and vitamin contents. So, as J. I. Rodale says in his book, *The Complete Book of Food and Nutrition*, "This whole thing about the importance of bread as the staff of life leaves me cold. I think the average person is better off to entirely restrict the use of bread."

Mr. Rodale also stated, "What is the best program for a person who wishes to live to 120? I say don't eat bread. It is the worst form of starch ... It is not an edible starch."

Article #6: Fruit - The Ideal Food by Dr. Herbert M. Shelton

Tradition has it that man's original diet was fruit. While we have no written history of a period when man lived on a fruit diet, there is plenty of evidence to substantiate the view that he once did so. We do know that fruits have historically constituted an important part of man's diet in most parts of the earth

from remote times. Only within recent centuries, and then only in certain parts of the earth, has the notion that fruits have little food value come about.

Most fruits are abundantly supplied with sugar and it is quite possible to gain weight on a fruit diet. Some fruits, like the avocado and most nuts (nuts are also fruits, technically speaking) contain considerable fat. While few of the pulpy fruits are abundantly supplied with protein, some of them do contain a higher percentage of protein than mother's milk. Practically all nuts are rich in protein of high biological value. One does not have to eat animal foods in order to supply himself with an abundance of all the amino acids required.

In the last century a veritable fruitophobia arose both in Europe and America and people refrained from eating fruits because they supposedly caused disease. Fruits were accused of causing various diarrheal diseases, even typhoid and cholera. It is a fact that a large excess of fresh fruit will result in loose stools, but this is not an objection to fruit eating. One has only to cease taking the fruit in excess to have the bowel looseness cease.

The body does not have to contend with sepsis or poison when an excess of fruit is eaten as when excesses of proteins or starches are taken. Excesses of all types are harmful, but an excess of fruit is far less harmful than an excess of bread or flesh. The prejudice against fruits, however, arose not so much out of the results of excess, as out of the faulty combinations in which they were eaten. Fruits are best taken at a fruit meal and should not be combined with starches or with foods rich in protein or fats, including nuts.

In the last century the idea arose that certain diseases such as rheumatism, gout, lumbago, arthritis, etc., were acid diseases. Acid fruits were forbidden on the ground that they helped to produce these diseases. This error about fruits is as dead as are those who promoted it, and it is somewhat surprising to have it revived at a time when our knowledge of foods is so much greater than it was in the last century.

Under the promptings of this revived notion, when people are told that their gastritis, arthritis, etc., arises out of acidity, many mistake this to mean that they arise out of taking acid fruits. They especially reject oranges, grapefruit, lemons, pineapples and similar acid fruits, lest these produce arthritis in them or aggravate the arthritis from which they already suffer.

The fact is that fresh fruits and vegetables, whether burned in the air or metabolized in the body, are alkaline. On the other hand, a diet of flesh, oils, sugar and denatured starches (white flour, polished rice, etc.) provides an excess of acids—sulphuric, etc. Even such acid fruits as oranges and grapefruit are alkaline when metabolized in the body. When fruit is cooked and sugar is added, the fermentation that follows gives rise to acids that add to the acidity of the body. (All canned fruits have been cooked and most have been sugared.)

As important as water is in the processes of life you do not need to drink large quantities of it. Under the usual circumstances of life the water in fruits and salads will supply all the water needed or nearly enough, if these are eaten as they should be. The pure water of fruits and vegetables is much better for physiological purposes than the water supplied by the water systems of our cities and towns.

Fruits appeal to the eyes, the nose and the mouth. Their beauty of color, their richness of aroma, and the deliciousness of their flavors make them ideally suited to man's gustatory delight. There is a rich variety of them and they ripen at various seasons of the year, so that there is but a small part of the year in which they are not abundant. Beginning with the many varieties of delicious berries in the springtime and progressing through the varied assortments of cherries, peaches, plums, nectarines, figs and mangoes of the summer season, to the apples, pears, persimmons, oranges and grapefruit of the fall and winter season, nature provides us with a pleasing assortment of delicious foods that may be enjoyed by everyone and that are easily digested by even the most sensitive stomachs. By the exercise of a little intelligent care in selecting and combining these foods, one may be assured of better health.

Article #7: Are Humans Starch Eaters? by Dr. Herbert M. Shelton

In his efforts to establish, to his complete satisfaction, the normal diet of man, Dr. Emmet Densmore pursued a line of reasoning that we may consider with profit. First, he noted that animals in their natural state live upon foods which are spontaneously produced by nature and require no cultivation. Man, on the other hand, he noted, lives upon foods that are produced by cultivation. Man does not live upon the spontaneous products of nature, but lives artificially.

The thought then occurred to him that, if nature has provided a *natural food* for all the animals below man, perhaps she has also provided a normal food for man. He assumed that nature has produced foods that are as normal to man as grasses are to the herbivore, or as flesh is to the carnivore. This was certainly no unreasonable assumption but is based on the principle of the *unity of nature*. It is based upon the fact that man, as much as the lion or the deer, is a child of nature and that, like these animals, his normal requirements are found in nature.

If man, like the other animals of nature, is constituted for a certain type of food, what is that food or what is that type? What, in other words, is the normal food of man? He sought for his answer in several directions. Scientists were agreed that man's original home was in a warm climate, either in the tropics or the subtropics. Without tools and without fire, he must have lived in a part of the world where the spontaneous productions of nature could be obtained by him with only the "tools" with which he is physiologically equipped and could eat without artificial preparation.

"If man first lived in a warm climate," he reasoned, "and, if like other animals, he subsisted on foods spontaneously produced by nature, these foods must have been those which grow wild in such a climate, quite probably such foods as are still spontaneously produced in such localities. The woods of the south, as is well known, abound in sweet fruits and nuts."

It will be seen at a glance that this line of reasoning led straight to the fruits of the trees as man's normal diet. But man does not live on a fruit diet. Indeed, the greater part of his diet has long been cereals and animal foods. Let us, then, see what Densmore found about cereals.

"It is taught by botanists that wheat is an artificial product developed from some grass plant not now known. Moreover, cereals are the product of the temperate zone, not of those regions where there is no winter, and it was, therefore a necessity of man's sustenance when he was without agriculture, without tools and without fire, and had to depend upon foods spontaneously produced by nature, that he live in a region where his natural foods were produced at all seasons of the year. This narrows or confines the inquiry to two articles of diet—fruit and nuts."

He next noted that these foods need no additions, no sweetenings, no seasonings, no preparations, to appeal to the olfactory and gustatory senses of man. "If the dishes that are set before a gourmet," he said, "those that have been prepared by the most skillful chefs, and that are the product of the most elaborate inventions and preparations, were set beside a portion of the sweet fruits and nuts as produced by nature, without addition or change, every child and most men and women would consider the fruits and nuts quite equal if not superior in gustatory excellence to the most *recherche'* dishes."

Analysis showed that these foods contain the proteins, carbohydrates, fats, and minerals that are essential to human nutrition. Subsequent analysis has shown them to be abundant in the various essential vitamins. Sugar, he noted, is the chief carbohydrate of fruits and nuts. In what way does this diet differ from the diet of civilization? Let us see how Densmore viewed this.

"Instituting a comparison between sweet fruits and nuts on the one hand, and the diet of civilization on the other, I soon detected an essential difference. I saw that bread, cereals, and vegetables are the basis of the diet of the present day and that starch is the chief element of these foods. Scrutinizing the component parts of fruits and nuts, I saw that these fruits contain very little starch, and hence I perceived that I had brought to light a fact that was not unlikely to bear an important part in the solution of the problem before me."

Thus, by a simple process of reasoning upon well-known facts of nature, he had arrived at the conclusion that, while man's normal diet as represented in the spontaneous products of nature contains little starch, the cultivated food plants of civilized man were abundant in starch. This led to the question: "What are the effects of starch upon the system?" "Wherein," he asked, "Does a diet that is without starch differ physiologically from one in which starch is the predominant element?"

Seeking a reply to this last question, he noted first of all "that the two foods (fruits and starch or cereals) involve a different process of digestion." "Sweet fruits are composed largely of glucose, with a fair proportion of nitrogen ..." cereals are composed largely of starch, with a higher proportion of nitrogen. The carbohydrate in nuts is largely sugar. If fruits and nuts constitute man's normal diet, as his reasoning had concluded, the starch diet is not his normal diet.

But he was met by one of the most convenient arguments that the evolution hypothesis has supplied its votaries. "Since man, by artificial contrivance and agriculture," it was reasoned, "has developed and employed cereals and starchy vegetables as the basis of his diet, he has reversed what appears to be the natural order." Densmore examined this contention in the light of anatomy and physiology and found that man's digestive organs have undergone no alterations in structure and function to adapt him to the starch diet. "The orangutan and the several species of long-armed apes, which have, apparently since time began, fed upon nuts and fruits to the exclusion of cereals and starchy vegetables, have today the same digestive apparatus in substantially the same proportion of parts as man, after his thousands of years of cereal eating. This fact is undeniable evidence that man's organs have not undergone essential modification or change by these centuries of unnatural diet." *Evolution just didn't evolve so readily.*

Analyzing the various mono-diets that were then popular and for which much was claimed in the way of their benefits to the patient, Densmore noted that the Salisbury meat diet, the grape diet, and the milk diet each were nonstarch diets. They were simple and, at the same time, they met another requirement of a diet—ease of digestion. "At the foundation of these diets," he said, "I was gratified to find the same basic fact that the diet is essentially nonstarch and one in which bread, cereals and starchy vegetables are reduced to a minimum." The Salisbury diet was, to quote Densmore, "entirely free from starch." He says of the Salisbury diet that it was "a uniform diet." It was usually considered that a variety of food is necessary both for the invalid and the robust. The triumphs of the mono-diets fly in the face of this commonly received axiom.

Can it be true, then, as Densmore contended, that invalids, and especially those suffering with digestive disease, are invariably benefitted by being placed on an exclusively nonstarch diet?" If man's digestive organs had undergone the modifications suggested by the defenders of the starch diet," he reasoned, "starch foods would naturally be those best adapted to man's restoration; but if, as we contend, the race has been, during all these thousands of years of cereal eating, perpetually straining and overcrowding the powers of the second stomach (the duodenum) and thus deranging the digestive apparatus—and if man is seen to be at once benefitted by discontinuing that diet, and by taking a food which is digested in the first stomach—these facts tend to confirm the view that the adoption of a nonstarch diet is in conformity with man's physiological structure and needs."

What he denominated *food fruits* consisted chiefly of sweet fruits—dates, figs, bananas, raisins, prunes, apples, nuts. Fruits and nuts, with the addition of green vegetables, constitute an adequate diet, furnishing all the food-factors needed by man's organism, and whoever eats a diet of this kind will be better off than he who eats a great variety of foods, from soup to nuts, from all the kingdoms of nature. It is not sufficient comment upon the abnormality of the modern diet that fruit is relegated to the last place

on the menu and is all too often used merely for ornamental purposes?

Prior to Sylvester Graham, the medical and conventional view of fruit was well expressed by a noted British physician thus: "for decorative purposes fruit equals flowers." Fruits were thought of, also, as relishes, but were not supposed to have any food value. "Bread and meat" were symbolic of nutriment, and those who could afford to do so often sat down to meals consisting of several types of flesh foods. Puddings, porridges and similar articles of diet were classed with bread.

"The ordinary dried figs of commerce," said Dr. Densmore, "contain about 68 percent glucose, which, when eaten, is in the identical condition that the starch of cereal food is converted into after a protracted and nerve-force-wasting digestion." He correctly observed that the sugar of fruits is predigested. Many of them require no preparation at all to render them ready to enter the bloodstream; others have to be reduced to simpler sugars, a process that takes place in the intestine. There is certainly good common sense in his thought that foods that are "predigested by nature" and are ready for absorption and assimilation upon ingestion and place less tax upon the digestive system than those foods that are prepared for assimilation only after a complicated and laborious process of digestion.

But, as man is equipped with ptyalin in the saliva and with starch-splitting enzymes in the intestine, it may be urged that starch may be thought of as constituting a normal part of his diet. It was the thought of Dr. Densmore that man's normal starch-digesting equipment is just sufficient to enable him to digest the small amounts of starch that normally exist in the fruits and nuts that constitute his normal diet. This thought is that, while man is equipped to digest a certain amount of starch, a predominantly starch diet such as is eaten in much of the world today is not normal to him, and that the best form in which he should secure his carbohydrates is sugar.

In this connection, sugar means the sweet fruits produced by old mother nature herself, not the processed sugars of commerce. Sugars, whether in the form of sugar (crystals-brown or white) or in the form of syrups that have been separated from their associated nutrients and that have been concentrated and changed, do not constitute ideal foods for man or beast. The maple sugar, cane sugar, beet sugar, milk sugar and fruit sugars of commerce and the syrups and molasses that are freely eaten, whether from cane or maple sap, do not constitute really good foods for man. Honey, even when pure and unchanged, is not a good food for man for much the same reason, and for added reasons. It is a fine food for bees.

It was believed in Densmore's day and it is still believed that toasting starch, as in toasting bread, dextrinizes it, thus rendering it more easily digested. Although the toasting of bread spoils much of the food value that remains in it after the first baking, and converts part of it into charcoal, precious little dextrinization occurs. Densmore, accepting the dextrinization of bread by toasting, said: "the sweet fruits are removed a step beyond. If there was some method by which a piece of toast could undergo a second transformation and the dextrin be converted into glucose, it would then in all probability be substantially as easy of digestion as the sweet fruits for the simple reason that it would already be glucose; in a word, no digestion would be necessary."

Certainly, as he contended, sweet foods would be far better for the weakened individual and the invalid, with lowered digestive powers, than would be a diet of starches. If there is one starch food that may be regarded as an exception to this rule, it would be the potato, as its starch is more easily and speedily converted into sugar than the starch of cereals, legumes, etc. But Densmore goes further than a consideration of the interests of the invalid when he says, "it would seem plain that a human being in apparently robust health is much more liable to remain so upon a food that is adapted to his organism and that is of easy digestion, than upon one that is a foreign body and that must undergo a protracted and difficult digestion before being of use to the system."